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MUSSF

SITE ASSESSMENT ACTION - WESTERN REGION
OREGON DEPARTMENT of ENVIRONMENTAL QUALITY

Facility Name: Musick Mine - Former

ECSI #: 2655

Address: T 23S, R 1E, Section 14, Tax Lot 2315140000300; Lane County

PRP:

Company: Musick Mining Co-op Inc.

Name: Contact: Gale Hulihan, (541) 689-8902

Address: 115 Hansen Lane
Eugene, OR 97404

Action Date: June 9, 2003

Report Type: Strategy Recommendation

Preliminary Assessment:

☐ State ☐ Federal ☐ Voluntary ☐ PAE ☐ XPA

Screening:

☐ State ☒ Federal ☐ Spill

QTIME No.: 25697

Note: Spill screenings may not require Strategy Recommendation

Recommended Action:

☐ NFA [Need management approval]

☐ Add to CRL

☐ Add to Inventory

☐ High Priority -- Requires immediate response

☒ Other

Describe: High Priority for XPA

Report Writer: Mary Camarata, WR:SAS

Headquarters

EPA

Other

Transmittal Date(s):

Report Supplement(s):


Sample Operating
Analysis Photos Plans Other

Supplemental Date(s):

Checklist:

☒ Strategy Recommendation ☒ Letter to RP ☒ SAPS ☒ Map ☐ SSR
☒ Data (if applicable) ☐ Spill Report (if applicable)

☐ Site Report

Manager's approval: 

USEPA SF



1196569

**DEQ SITE ASSESSMENT SECTION
ABANDONED MINE LAND
STRATEGY RECOMMENDATION**

Site Name: Musick Mine - Former

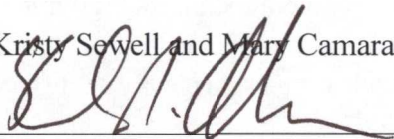
Site Owner and Contact Person: Musick Mining Co-op Inc.
Gale Hulihan
115 Hansen Lane
Eugene, OR 97404
Phone: (541)689-8902

Site CERCLIS Number: N/A

DEQ ECSI Number: 2655

Site Location: T 23S, R 1E, Section 14, Tax Lot 2315140000300,
Lane County

Recommendation By: Kristy Sewell and Mary Camarata

Approved By: 
Keith Andersen
Manager, Regional Environmental Solutions
Western Region, Eugene

Date: June 9, 2003

Background and Purpose

United States Environmental Protection Agency (EPA) Region 10, in conjunction with northwest states and federal land management agencies, has begun a region-wide program to evaluate abandoned mine lands (AML)¹. The U.S. Bureau of Land Management (BLM) and U.S. Forest

¹ In Oregon abandoned mine lands include abandoned, inactive, or non-permitted (i.e., not permitted as active mines with the Oregon Department of Geology and Mineral Industries) mine sites.

Service are responsible for evaluating mines on federal property. In Oregon, the Oregon Department of Environmental Quality (DEQ) is responsible for evaluating AML sites on private property.

In most of western Oregon AML evaluations are being conducted under the Western Region abandoned mine land screening program. This program is part of DEQ's Site Assessment Section. The purpose of the abandoned mine lands screening program is to rapidly identify AML sites that may have significant impacts to water quality, the environment, human health and safety, such as:

- acid mine drainage (AMD);
- erosion of mill tailings or waste rock piles into streams;
- human health or environmental concerns such as contaminated soil and/or drinking water; and,
- safety issues such as open adits, shafts, unstable buildings.

There are approximately 400 mines and prospects in DEQ's Western Region. Of these, 32 hard rock (lode) metal mines were selected for evaluation during the initial phase of the program. The primary selection criteria include:

- located in watersheds with core salmonid habitat or drinking water intakes;
- over 1000 feet of underground workings;
- known adits, tailing piles, mills, large production, or known or suspected AMD;
- located on private land.

Site screenings conducted under the abandoned mine lands screening program generally include the following items:

- a review of available site information and interviews with site owners, former owners, employees, neighbors, and others familiar with the site (as available);
- a site inspection; and,
- an evaluation of the need for further investigation or remedial action at the Site with a priority for such action based on potential impacts to human health and the environment, including any imminent threats that need immediate corrective action.

These evaluations are not intended to be a full investigation or characterization of the Site. No rock, soil, or water samples were collected by the DEQ for laboratory analysis of hazardous substances or acid-generating potential. Conditions may exist at the Site which are not identified in this evaluation.

The former Musick Mine Site (Site) was selected for evaluation under the abandoned mine land

screening program based on the following criteria: 1) is primarily located in the City Creek watershed which is considered salmonid habitat, 2) has 7,660 feet of underground workings, 3) has at least one adit with suspected acid mine drainage (AMD) as well as known tailing piles, and 4) is located on private land. The Site is located in the Bohemia Mining District in Lane County approximately 35 miles southeast of Cottage Grove, Oregon (Figure 1 - Location Map).

DEQ was not granted access to the property and did not conduct an on-site reconnaissance inspection. However, a portion of the Site was visible from Fairview Road, and on August 21, 2002, site assessment section (SAS) staff members Mary Camarata and Bryn Thoms were able to make limited field observations and take distant photos (see Attachment C). In addition, DEQ sent an information request to the property owner on September 18, 2002. The property owner did not respond to the request. Therefore, this evaluation is based on information available in literature, from limited conversations with Gale Hulihan of Musick Mining Co-op, the Bohemia Mining Association, and the U.S. Forest Service, and from remote field observations.

Pre-Screening Information and Funding

Based on past experience at similar abandoned mine sites in Oregon, CERCLIS-eligible contaminants may be present at the Site. Based on the potential presence of CERCLIS-eligible contaminants, this evaluation is being performed as a CERCLIS Federal Screening funded under an agreement with the U.S. Environmental Protection Agency (Cooperative Agreement V-990519-02).

Site Description

The former Musick Mine is located in the Bohemia Mining District in Lane County, approximately 36 miles southeast of Cottage Grove, Oregon in Township 23 South, Range 1 East, Sections 14 and 15 (Figure 1 - Location Map). The former Musick Mine consists of the Upper Musick Mine located on the southeast side of Bohemia saddle, and the Lower Musick Mine located on the northwest side of the Bohemia saddle. The USGS topographic quadrangle presents two adits at the Lower Musick Mine which are mislabeled as the neighboring Vesuvius mine. The Site elevation ranges from about 4,300 feet to 5,400 feet above sea level on slopes of Bohemia Mountain. Other principle mines within the district include the Champion, Helena, Noonday (Annie), and Vesuvius Mines. The former Musick Mine is approximately 1 mile west of the Champion Mine on County Road 2473.

The former Musick Mine consisted of 14 unpatented mining claims which lie mostly in the basin of City Creek (Upper Musick Mine) but extend across the divide into the basin of Sharps Creek (Lower Musick Mine) [Gold and Silver in Oregon, 1968; Callaghan and Buddington, 1938]. According to the mine and mineral deposit reports on the Bohemia Mining District, the mine produced gold, silver, copper, lead and zinc ores [Oregon Metal Mines Handbook, 1951]. Total production from the former Musick Mine up to 1949 may have been about \$280,000 [Taber,

1949].

The Musick vein was the first mineralized vein discovered in the district in 1891, and it differs from most other veins in the district by having sharp bends in its course [Callaghan and Buddington, 1938]. The main portal is located on the City Creek side near the base of Bohemia Mountain. The north-west striking Musick vein merges with the west-striking California vein on the west side of the ridge, and ranges from 3 to 12 feet in thickness. The veins contained a mixture of sulfide minerals in a silicious-gangue ore with fragments of country rocks [Taber, 1949]. The country rock consisted of rhyolite with a few exposures of andesite and tuff. Both the California and Musick veins have been explored for more than a mile along their strike to a depth of 800 feet [Gold and Silver in Oregon, 1968].

History and Site Operations

The early operational history on the City Creek side included several owners and operators with the major years of production in 1891-1939. The year after discovering the vein, a 5-stamp mill was constructed on the property and the mine was operated continuously until 1901. In 1902, the Musick property was consolidated with the Champion and the Helena Mine, and the ore was transported to the Champion Mine and processed at the Champion 30-stamp mill until 1907. In 1935, a 22-ton gravity concentrator mill was built to produce ore concentrates. Sometime after 1946, measurements indicated that the amount of rock stoped was at least 40,000 tons [Taber, 1949]. Taber noted that all the equipment except the tracks had been removed from the mine. There was a small mill building and 50-ton capacity coarse-ore bin still on site, and the mine camp included a 30-man bunkhouse, a cookhouse, and four dwelling houses. In 1949, additional ore from the former Musick Mine dump was hauled to the Champion mill for treatment [Gold and Silver in Oregon, 1968]. Additional exploratory work was completed in 1961 and 1962 on the Lower Musick Mine area when a 1,662 foot drift tunnel was completed on the Sharps Creek side of the Site; however, very little additional ore was found. In all, the former Musick Mine was explored on four levels and had more than 7,660 feet of drifts and crosscuts, plus several stopes and raises [Gold and Silver in Oregon, 1968].

The Site operations did not include smelting. All of the mining districts in the western cascades were dependent on off-site smelting facilities such as those located in Tacoma, Washington and Selby, California [Oregon Metal Mines Handbook, 1951].

Site Reconnaissance Inspection

DEQ did not conduct a site inspection since access to the property was not granted. However, a portion of the Upper Musick Mine was visible from Fairview Road and a portion of the Lower Musick Mine was visible from county road 2460. DEQ made limited field observations and took distant photos of the mine sites (see Attachment C). The photos show apparent tailing piles and/or other mining wastes that are void of vegetation and appear to be eroding. In addition,

according to U.S. Forest Service, there is discolored discharge draining from the Upper Musick Mine into City Creek, a tributary to Steamboat Creek. DEQ was not able to assess if there are physical hazards associated with the Site.

Hazardous Substance Release Information

General Hazardous Substance Information for AML Sites

Hazardous substances at AML sites can include toxic metals from mine minerals, such as chromium, copper, lead, zinc, mercury, nickel, and metalloids such as arsenic and selenium. Metals can be of economic interest, whereas arsenic (often associated with gold and mercury deposits) is usually considered an unusable byproduct. Contaminants of concern (COCs) may or may not be related to the commodities mined at a particular AML site. For example, commodities mined may have included gold and silver, but COCs could include metals present at sub-economic concentrations.

Contaminants of concern can also include materials used to process the ore, such as mercury for amalgamation and sodium cyanide for flotation or heap and vat leaching. Petroleum hydrocarbons associated with fuels and polychlorinated biphenyls (PCBs) associated with electrical transformers are additional potential COCs.

Abandoned mine sites containing sulfide minerals can impact ground and surface water resources due to acid mine drainage. Most sulfide minerals react with oxygen and water, and some common sulfides, especially those containing iron and copper, generate sulfuric acid in the process. Sulfide minerals may be extensively exposed in mine wastes and mill tailings due to the small size and high surface area of the waste particles. The acid will attack more resistant sulfides of other metals. The amounts of pyrite and other iron-rich sulfides such as marcasite, pyrrhotite, and chalcopyrite are critical in producing AMD. AMD tends to carry high concentrations of metals and metalloids such as copper, zinc, cadmium, nickel, lead, mercury, and arsenic. Secondary minerals comprised of soluble sulfate salts may also be formed at AML sites. These salts can precipitate during dry times of the year coating the walls of mine workings and the surfaces of dumps and tailings piles. With the return of wet conditions or spring snowmelt, these salts dissolve readily and add metals to the water.

Hazardous Substance Release Information at the Former Musick Mine

A mixture of sulfide ores was reported in the literature for the former Musick Mine. Other mines in the Bohemia Mining district typically contained sphalerite, pyrite, chalcopyrite, galena, and tetrahedrite. Specific minerals were not listed; however, it was noted that the former Musick Mine ore contained a slightly lower gold content and higher lead content (galena) than other veins in the district [Gold and Silver in Oregon, 1968].

Limited analytical data was available from a University of Oregon study by Rebecca Ambers and Bretagne Hygelund on *Contamination of Two Oregon Reservoirs by Cinnabar Mining and Mercury Amalgamation*. Samples were collected from Musick Mine settling pond fines near City Creek and Upper and Lower Musick waste rock in April 1999. The samples were analyzed for 30 metals.

To screen for possible human health risk DEQ compared the sample results to the EPA Region 9 Preliminary Remediation Goals (PRGs) dated October 2002. To screen for possible ecological risk DEQ compared the results to DEQ's Level II Screening Levels for plants, invertebrates, and wildlife. Table 1 summarizes the sample results for metals that exceeded human health or ecological risk screening values.

<p>Table 1 Musick Mine Sample Results (all values are in mg/kg)</p>			
Metal	Sample Concentration Range	Residential PRG	Ecological Screening Value Range ⁽¹⁾
Arsenic	368 to 427	0.39	10 to 60
Copper	1,203 to 4,530	3,100	50 to 390
Lead	4,620 to > 10,000	400	16 to 4,000
Manganese	111 to 2,244	1,800	100 to 500
Mercury	13.4 to 44.8	6.1/23 ⁽²⁾	0.1 to 1.5
Silver	13.6 to 72.6	390	2 to 50

Notes: 1) Screening values vary for plants, invertebrates, birds, and mammals

2) Mercury PRGs are for methyl mercury and mercury chloride, not elemental mercury

Arsenic, copper, lead, manganese, and mercury exceeded human health screening levels.

Arsenic, copper, lead, manganese, mercury, and silver exceeded ecological screening levels.

There is no data available for metals in adit water or surface water. However, the U.S. Forest Service reported drainage from the Upper Musick Mine Site flowing into City Creek in August 1993 had a pH of 3.9.

Pathway Information

In general the area is used by hardrock miners, river suction-dredge miners, and the occasional recreational user such as mountain bikers, fishermen, and hunters. From DEQ's limited vantage point during the site reconnaissance inspection, permanent structures such as homes were not observed in the immediate area. However, according to literature a portion of old mining camp existed on the property in late 1940's.

Surface Water Pathway: Drainage from the Upper Musick Mine area is into City Creek which is a tributary to Steamboat Creek. Steamboat Creek drains into the North Umpqua River. The North Umpqua River provides habitat for salmon, steelhead, and resident trout. There is a potential for impacts to the creeks and rivers.

Drainage from the Lower Musick Mine area is into Sharps Creek which is a tributary of the Row River. The Row River drains into Dorena Lake. Due to the elevated levels of mercury in fish tissue, the Oregon Department of Human Services issued a fish consumption advisory for Dorena Lake in 1997. There are trout in the creeks but migratory species such as salmon are not able to pass by the dam at Dorena Lake.

It is unknown to DEQ if surface water is used to supply drinking water at the Site.

Groundwater Pathway: According to the Oregon Water Resource Department, no wells are located in the area. It is unknown to DEQ if groundwater or adit drainage is used at the site

Direct Contact/ Soil Ingestion Pathway: Direct contact with or incidental ingestion of soil containing metals is possible by people who may use the site. Information is not available to DEQ on whether trespassers may enter the property or how the property owner currently uses the Site.

Air Pathway: Inhalation of soil dust containing metals is possible by people who may use the site. Information is not available to DEQ on whether trespassers may enter the property or how the property owner currently uses the Site.

Recommendation/Action

Based on the available information for the former Musick Mine, DEQ finds that further action is required. DEQ recommends that an expanded preliminary assessment (XPA) be conducted. The XPA should include, but not be limited to, a site inspection and sampling. The purpose of the XPA is to assess:

- the presence and nature and extent of any acid mine drainage,
- erosion of mining wastes into City Creek and/or Sharps Creek,
- the amount, extent, and estimated volume of tailings piles, waste rock,
- the former mill area and any associated mine wastes (e.g., concentrates, settling ponds etc.)
- concentration of metals in Site soil, in City Creek and Sharps Creek sediments, in City Creek and Sharps Creek surface water, and in mine drainage,
- current use(s) of the Site (e.g., dwellings, recreational uses, use of surface and/or groundwater)

As indicated by the site inspection the XPA should include sampling of surface soil, mine tailings, surface water, and sediments. These samples would be analyzed for metals including arsenic, copper, lead, manganese, mercury, silver, and zinc. Other analyses may also be warranted.

The priority for further action at the Site is considered high based on the Site Assessment Prioritization System (SAPS) score. The SAPS score is provided as an attachment to this document.

Coordination Within or Outside DEQ

DEQ has contacted the Bohemia Miner Association, the Oregon Department of Geology and Mineral Industries, DEQ's Water Quality TMDL Program, and the United States Forest Service for information about the area.

References

The following references were reviewed in the preparation of this strategy recommendation:

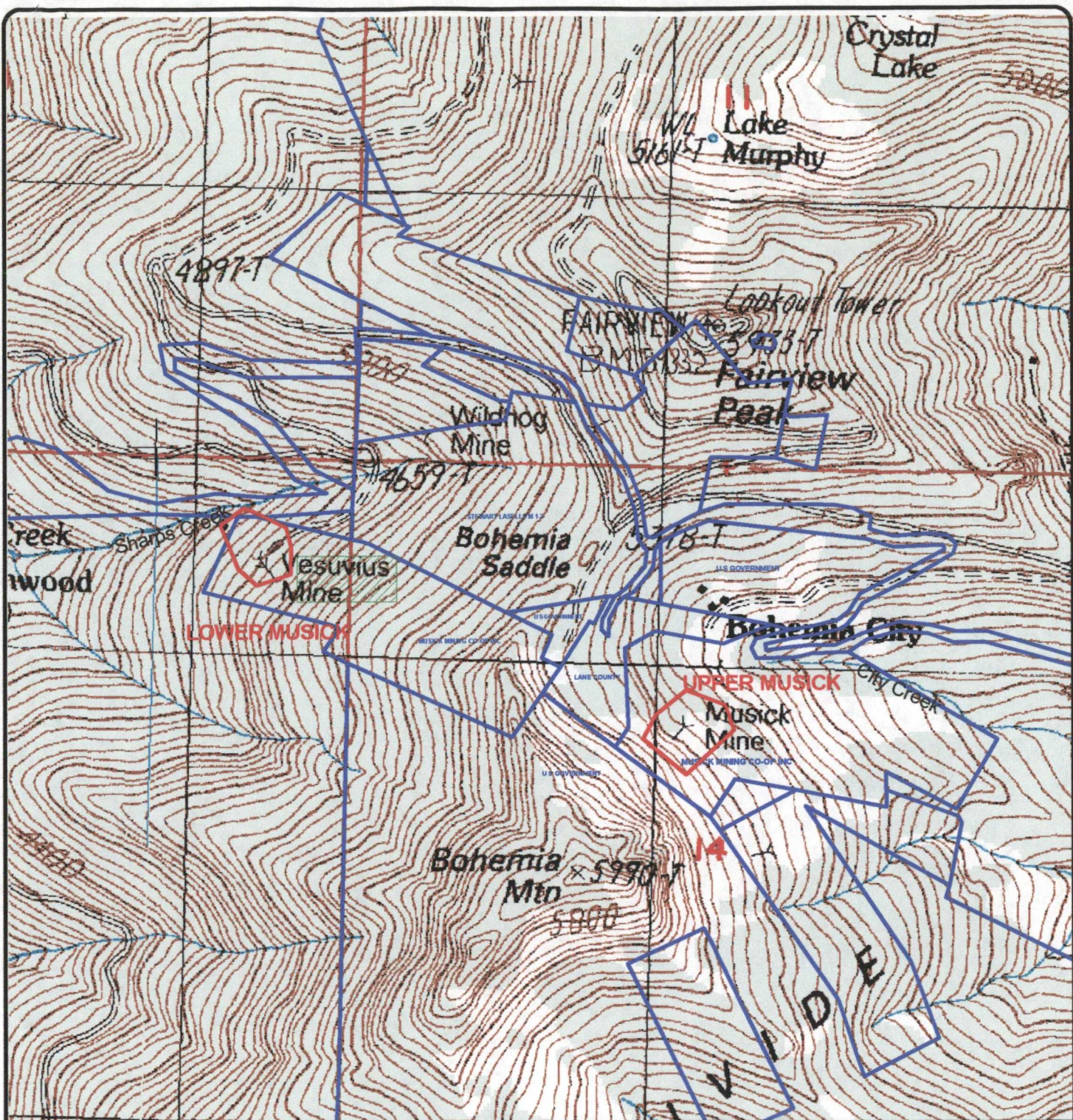
1. Abandoned Mine Lands Preliminary Assessment Handbook, State of California Environmental Protection Agency, January 1998.
2. A Reconnaissance of Lode Mines and Prospects in the Bohemia Mining District, Lane and Douglas Counties, Oregon., John W. Taber, August, 1949.
3. Bulletin 14-D, Northwestern Oregon: Oregon Metal Mines Handbook, State of Oregon Department of Geology and Mineral Industries, by the Staff, 1951.
4. Bulletin 61, Gold and Silver in Oregon, State of Oregon Department of Geology and Mineral Industries, Brooks and Ramp, 1968.
5. Bulletin 893: Metalliferous Mineral Deposits of the Cascade Range in Oregon, United States Department of the Interior, Eugene Callaghan and A.F. Buddington, 1938.
6. Contamination of Two Oregon Reservoirs by Cinnabar Mining and Mercury Amalgamation. Rebecca K. R. Ambers and Bretagne N. Hygelund, October 7, 1999.

Attachments

A. Photos

B. SAPS Scoresheet

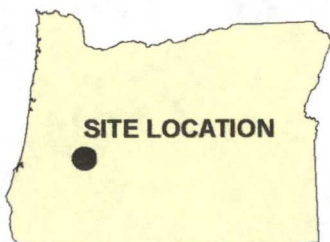
- C. Excerpts from A Reconnaissance of Lode Mines and Prospects in the Bohemia Mining District, Lane and Douglas Counties, Oregon; Bulletin 14-D, Northwestern Oregon: Oregon Metal Mines Handbook; Bulletin 61, Gold and Silver in Oregon; and Bulletin 893: Metalliferous Mineral Deposits of the Cascade Range in Oregon; Contamination of Two Oregon Reservoirs by Cinnabar Mining and Mercury Amalgamation



Base Map: USGS topographic Quadrangle 43122e6 and Lane County Tax lot data 2000



500 0 500 1000 Feet



Legend

— Tax Lot Boundary

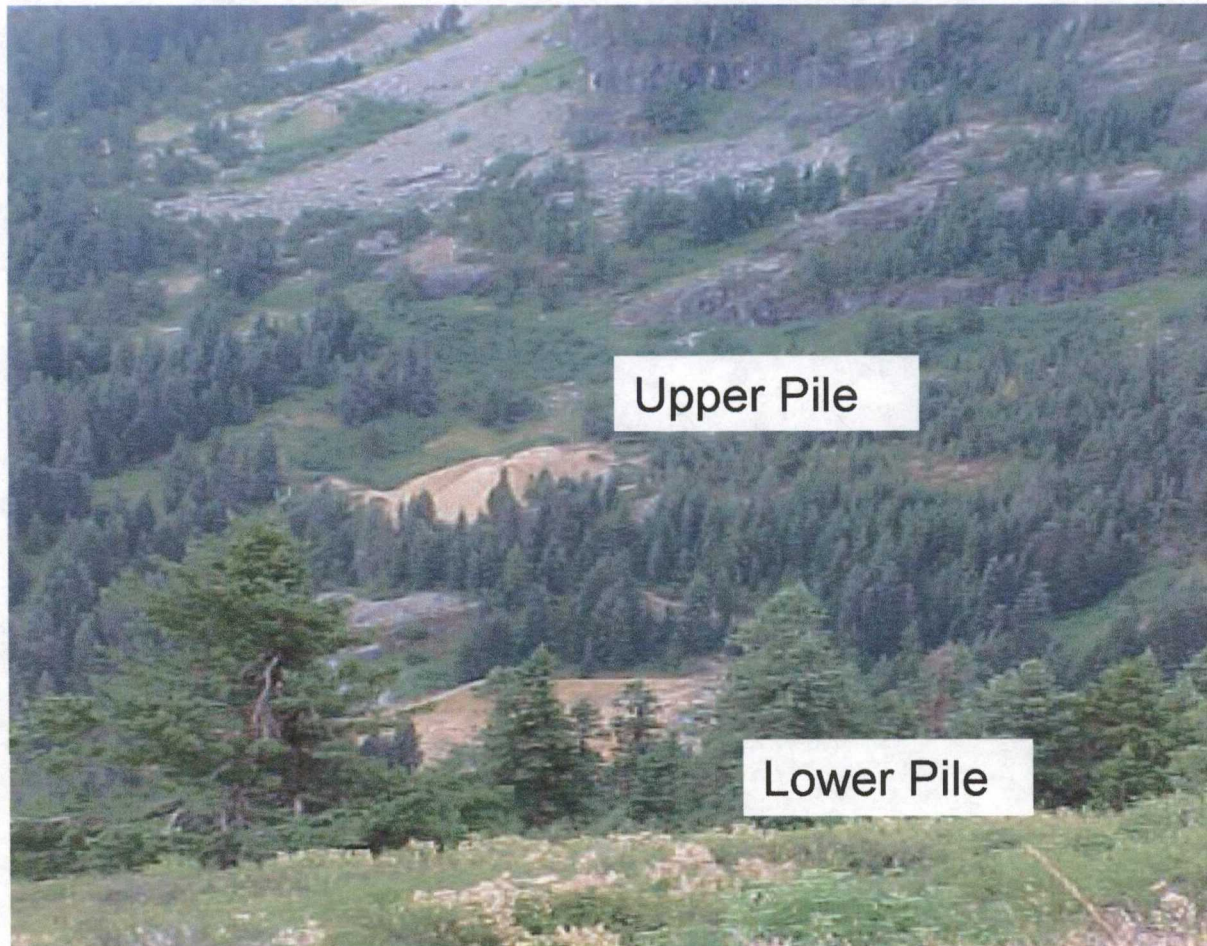
Figure 1
Musick Mine
Lane County



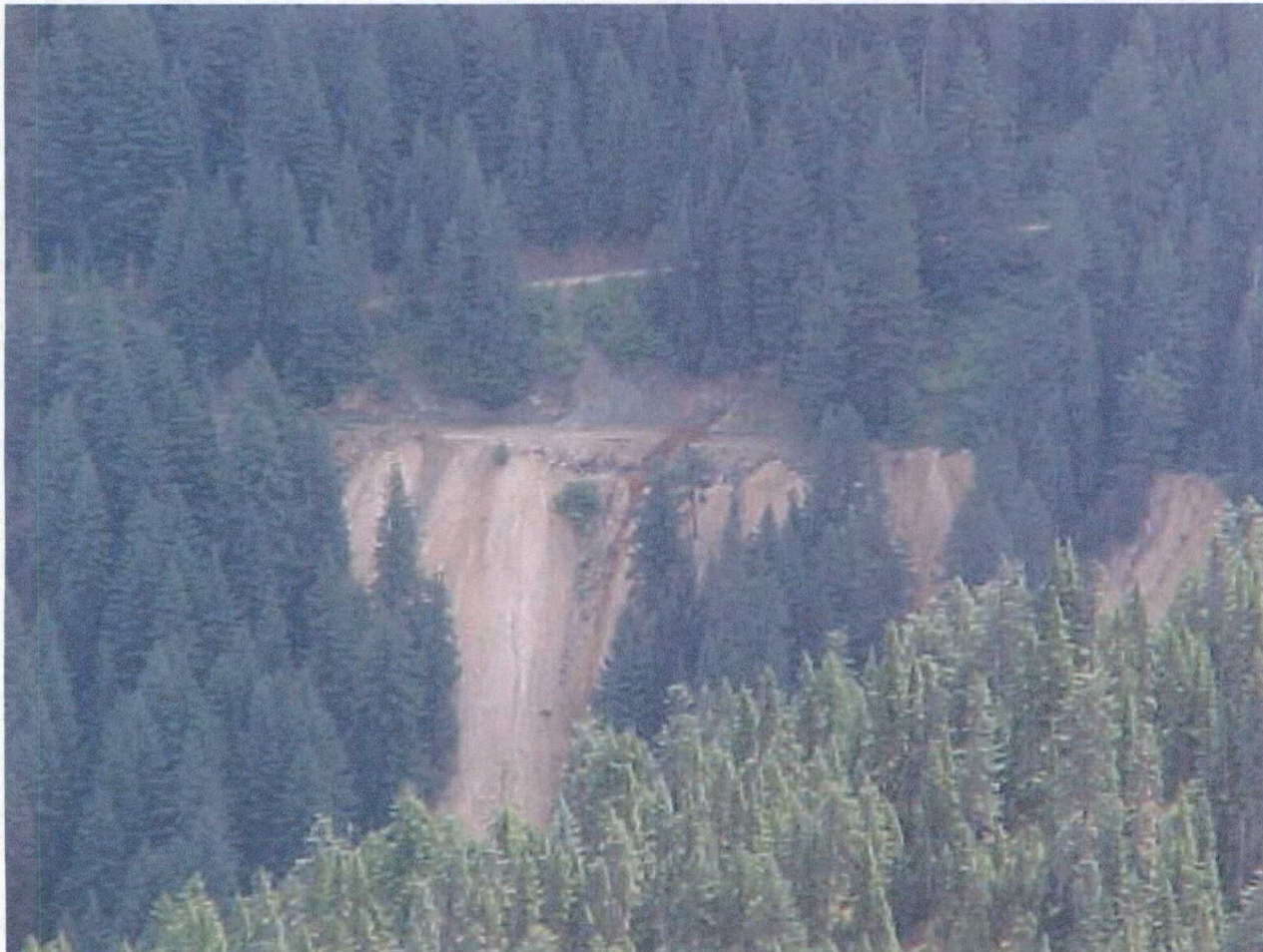
State of Oregon
Department of
Environmental
Quality

Attachment A – Photos

Upper Musick Mine Tailings Piles



Upper Musick Mine Lower Tailings Pile



Upper Musick Mine Upper Tailings Pile



Lower Musick Mine Waste Rock



Attachment B – SAPS Scoresheet

SITE ASSESSMENT PRIORITIZATION SYSTEM (SAPS) - SCORESHEET

(To be used with SAPS Guidance & Worksheet Version #5, September 2000)

Site Name: Musick Mine Site

Site Address: Bohemia Mining District, Lane County approximately 35 miles southeast of Cottage Grove, Oregon, T 23S, R 1E, Section 14.

ECSI Number: 2655

EPA ID Number: Not Applicable

Site Evaluator: Kristy Sewell and Mary Camarata

Date: June 9, 2003

	<u>HIGH THREAT</u>	<u>MEDIUM THREAT</u>	<u>LOW THREAT</u>	<u>NO THREAT</u>	<u>CONF. VALUE</u>
1. Contaminant Route Characteristics and Potential to Release					
a. Hazardous Substance Containment	9✓	5	3	0	B
b. Depth To Aquifer	7	4	2✓	0	C
c. Distance to DW Well	7	4	2✓	0	C
d. Soil Permeability	3	2✓	1	0	C
e. Distance to Surface Water	7✓	4	2	0	B
2. Hazardous Substance Characteristics					
a. Source Quantity	9✓	5	3	0	C
b. Toxicity/Persistence	9✓	5	3	0	B
c. Water Solubility	3	2✓	1	0	A
3. Exposure Potential					
a. Groundwater Use	9	5	3✓	0	B
b. Land Use/Population	7	4	2✓	0	C
c. Surface Water Use	9	5✓	3	0	C
d. Sensitive Environments	7✓	4	2	0	C
e. T&E Species and Critical Habitats	7✓	4	2	0	C
f. Direct Contact	7	4✓	2	0	B
4. Evaluator Assessment of Threat	10✓	5	1	0	C

Add the circled numbers to get the total SAPS score.

Total SAPS score = 80 (out of 110 possible points)

Raw priority associated with score = Medium

HIGH: 86 – 110

MED: 48 – 85

LOW: 47 or less (where further site action is needed)

DISCUSSION:

Discuss your overall impression of the threat posed by the site. Include brief discussion of major factors such as potential or known releases, waste quantity, human and environmental targets, and beneficial use(s) of nearby groundwater or surface water. Also discuss relevant factors or considerations not addressed in the SAPS scoresheet. If applicable, explain why the total SAPS score does not reflect the threats the site may pose to human health or the environment.

This screening was based on information available in literature, from limited conversations with Gale Hulihan of Musick Mining Co-op, the Bohemia Mining Association, and the U.S. Forest Service, and from remote field observations.

According to the literature the former Musick Mine was one of the large gold producers in the Bohemia Mining District. The mine had extensive workings and large production in the Bohemia Mining District. There was approximately 3,000 feet of workings and approximately \$280,000 gold production from the ores. The literature also reported the mine site had a 5-stamp mill in the late 1800's and 22-ton concentration mill installed in 1935. There were 3 large tailing piles observed from the Fairview Road.

Even though a site visit was not conducted, there was some analytical data available to assess potential impacts from past mining activities. In August 1993, the U.S. Forest Service during an inspection of mining claims in the area noted acid mine drainage with a pH of 3.9 discharging from the Upper Musick Mine Site flowing into City Creek. DEQ did a preliminary human health and ecological screening on samples collected from mine wastes in April 1999. Several metals (i.e. arsenic, copper, lead, manganese, and mercury) were found to be above the screening values for human and ecological receptors.

Due to the large production size of the mine, the large volume of mine wastes, historical mills used at the site, reported drainage with low pH, and elevated metals in samples collected from the site. DEQ adjusted the raw priority score from a medium to high priority for expanded preliminary assessment (XPA). The Musick Mine Site is ranked as a high priority to obtain data to evaluate actual environmental conditions and possible threats to the environment.

FINAL PRIORITY ASSIGNMENT:

- ☒ Further Action - High Priority
- ☐ Further Action - Medium Priority
- ☐ Further Action - Low Priority
- ☐ No Further Action
- ☐ Refer to _____ for further consideration
- ☐ Other: _____

LISTING RECOMMENDATION:

- ☐ Recommend proposal on Confirmed Release List
- ☐ Recommend proposal on Inventory
- ☒ Insufficient information to list on the Confirmed Release List
- ☒ Insufficient information to list on the Inventory
- ☐ Excluded from listing

Attachment C – Excerpts from Literature

Summary of assay results - analytical testing by Bondar-Clegg Mineral Laboratories

Soil sampling by Rebecca Ambers (1999)

	Sample No.	Ag	As	Au	Au	Ba	Bi	Cd	Co	Cr	Cu	Ga	Hg	La	Li	Mn	Mo	Nb	Ni	Pb	Sb	Sc	Sn	Sr	Ta	Te	V	W	Y	Zn	Zr	Al	Ca	Fe	K	Mg	Na	S	Ti	
Sharps Creek																																								
Martin Cr. trib. above confluence with Puddin Rock Cr.	SC-20	0	89	—	0.007	148	0	0.5	13	12	11	6	0.072	13	19	1071	1	3	7	20	0	5	0	18	0	0	47	0	10	115	1	2.47	0.24	3.9	0.1	0.63	0.02	N/R	0.02	
lower reach Quartz Creek trib.	SC-18	0	34	—	0	157	0	0	16	15	17	6	0.093	12	16	916	1	3	9	9	0	5	0	36	0	0	57	45	9	76	2	2.58	0.42	3.91	0.14	0.64	0.05	N/R	0.03	
Martin Cr. above confluence with mainstem Sharps Cr.	SC-16	0	52	—	0	125	0	0.4	13	14	13	4	0.085	12	15	849	1	3	8	12	0	5	0	20	0	0	48	24	8	85	2	2	0.28	4.03	0.11	0.58	0.02	N/R	0.03	
mainstem Sharps Cr. near Minerals Campground	SC-15	0.3	54	—	0.052	103	0	0.6	16	12	19	5	0.430	13	21	948	1	3	8	45	0	5	0	17	0	0	46	22	10	146	2	2.23	0.26	4.15	0.16	0.57	0.03	N/R	0.04	
lower reach Fairview Cr. trib.	SC-14	0	25	—	0	91	0	0.3	16	14	14	4	0.156	13	19	747	1	2	9	9	0	6	0	22	0	0	51	25	9	96	3	1.89	0.34	4.02	0.16	0.54	0.03	N/R	0.04	
mainstem Sharps Cr. below Walker Cr. trib.	SC-12	0	38	—	0.007	115	0	0.2	17	13	15	4	0.172	12	16	766	1	3	9	15	0	5	0	25	0	0	59	26	8	91	4	2.03	0.32	4.24	0.16	0.55	0.03	N/R	0.06	
mainstem Sharps Cr. above Staples Cr. trib.	SC-8b	0	26	—	0	143	0	0.3	21	12	18	6	0.140	13	15	890	N/R	3	10	10	0	7	0	48	0	0	61	50	9	85	7	2.53	0.47	4.09	0.21	0.56	0.05	N/R	0.08	
mainstem Sharps Cr. above Pony Cr. trib.	SC-6	0	27.5	—	0.021	108.5	0	0.3	20.5	17.5	18	4	0.180	12	13	816	1	6	9.5	12.5	0	6	0	36.5	0	0	102	26.5	8	108	7	1.935	0.40	5.19	0.13	0.52	0.03	N/R	0.14	
mainstem Sharps Cr. above confluence with Row River	SC-2	0	20	—	0	132	0	0	17	13	18	5	0.172	12	13	963	1	3	9	8	0	8	0	80	0	0	66	0	9	84	7	2.28	0.50	4.45	0.13	0.57	0.03	N/R	0.09	
Brice Creek																																								
mainstem Brice Cr. above confluence with Grass Creek trib.	BC-50	0	14	—	0	144	0	0	29	10	21	5	0.093	10	12	1055	0	5	6	12	0	9	0	85	0	0	83	22	11	114	5	3.59	0.83	4.83	0.14	0.62	0.09	N/R	0.119	
upper reach Grass Creek trib. above confluence with Brice Cr.	BC-49	0	20	—	0	155	0	0.2	35	27	26	5	0.064	11	13	1166	0	11	11	22	0	8	0	73	0	0	162	37	10	186	5	3.24	0.76	6.9	0.21	0.56	0.12	N/R	0.248	
lower reach Grass Creek trib. above confluence with Brice Cr.	BC-48	0	21	—	0	151	0	0	29	18	27	4	0.053	11	17	982	0	5	9	18	0	10	0	80	0	0	93	35	11	144	4	3.59	0.86	5.18	0.23	0.76	0.1	N/R	0.123	
mainstem Brice Creek below confluence with Parker Cr. trib.	BC-47	0	23	—	0	112	0	0	28	24	27	4	1.215	9	16	938	0	6	10	14	0	9	0	74	0	0	111	0	10	123	3	3.32	0.82	5.81	0.14	0.81	0.08	N/R	0.134	
lower reach Parker Cr. trib. to Brice Cr.	BC-46	0	50	—	0	142	0	0	33	22	27	5	0.049	12	10	1537	0	6	10	11	0	10	0	65	0	0	103	0	13	127	0	4.7	0.70	7.07	0.17	0.78	0.05	N/R	0.074	
lower reach Wyatt Cr. trib. to Brice Cr.	BC-45	0	31	—	0	108	0	0	30	25	15	4	0.061	10	8	783	0	8	9	6	0	8	0	41	0	0	131	61	11	70	0	2.74	0.50	6.68	0.11	0.53	0.05	N/R	0.117	
mainstem Brice Creek below confluence with Wyatt Cr. trib.	BC-44	0	28	—	0	101	0	0	56	23	25	4	0.062	9	14	841	0	6	9	10	0	9	0	74	0	0	102	138	9	100	3	3.06	0.87	5.62	0.15	0.78	0.09	N/R	0.119	
mainstem Brice Cr. above confluence with Champion Cr.	BC-31	0	30	—	0	88	0	0.4	28	44	24	4	1.205	9	12	813	2	14	16	9	0	8	0	54	0	0	234	20	9	117	2	2.37	0.74	9.08	0.09	0.72	0.06	N/R	0.25	
lower reach Weaver Cr. trib. to Champion Cr.	BC-30b	0.2	68	—	0.445	80	0	1.8	38	31	120	5	0.586	8	23	952	2	5	15	248	6	8	0	39	0	0	96	68	9	379	4	2.6	0.68	4.95	0.16	1.11	0.04	N/R	0.115	
lower reach Weaver Cr. trib. to Champion Cr.	BC-30a	0.3	46	—	0.319	54	0	1.4	18	26	87	4	0.386	7	21	879	2	3	13	134	0	6	0	27	0	0	72	0	7	288	2	2.39	0.45	4.7	0.08	1.07	0.03	N/R	0.1	
mainstem Brice Cr. at Lund Park Campg.	BC-28	0.35	40.5	—	0.184	58	0	0.95	19	26	74	4	0.365	7	17.5	799	2	5.5	13	126	0	7	0	36.5	0	0	87.5	0	7.5	221	4	2.375	0.57	5.11	0.08	0.965	0.04	N/R	0.115	
mainstem Brice Cr. above confluence with Cedar Cr. trib.	BC-27	0.4	43	—	0.203	73	0	1.1	21	34	61	4	1.211	8	15	806	2	9	15	122	0	7	0	38	0	0	151	0	8	236	4	2.2	0.62	6.87	0.08	0.84	0.04	N/R	0.18	
mainstem Brice Cr. above confluence with Adams Cr. trib.	BC-26	0	30	—	0.078	85	0	0.9	19	24	45	4	0.289	9	15	865	1	6	12	91	0	7	0	40	0	0	113	0	8	207	4	2.39	0.60	5.46	0.08	0.83	0.04	N/R	0.14	
mainstem Brice Cr. above confluence with Alder Cr. trib.	BC-25	0.3	30	—	0.372	80	0	0.8	20	30	48	4	1.339	8	13	740	1	10	14	124	0	7	0	39	0	0	161	0	7	226	5	2.2	0.57	6.6	0.09	0.74	0.04	N/R	0.2	
mainstem Brice Cr. above confluence with Layng Cr.	BC-23	0.2	27	—	0.148	96	0	0.6	26	27	44	5	0.396	10	15	899	2	7	12	73	0	9	0	55	0	0	123	41	9	198	7	2.69	0.71	5.72	0.13	0.77	0.07	N/R	0.17	
Layng Creek																																								
lower reach Alex Cr. trib. to Layng Cr.	LC-43	0	7	—	0	283	0	0.2	21	9	21	8	0.040	12	8	1212	0	3	8	4	0	15	0	184	0	0	82	0	12	81	22	4.22	0.78	4.85	0.12	0.61	0.09	N/R	0.13	
lower reach Herman Cr. trib. to Layng Cr.	LC-42	0	8	—	0	165	0	0	27	15	18	6	0.100	12	9	913	1	4	8	4	0	9	0	84	0	0	78	0	10	83	6	3.23	1.23	4.32	0.12	0.5	0.08	N/R	0.09	
mainstem Layng Cr. below confluence with Harvey Cr. trib.	LC-35	0	7	—	0	187	0	0	17	12	16	5	0.045	11	7	894	0	3	12	4	0	8	0	115	0	0	68	0	10	67	12	2.62	0.91	3.88	0.11	0.51	0.07	N/R	0.09	
lower reach Junetta Cr. trib. to Layng Cr.	LC-34	0	10	—	0	153	0	0	24	22	31	7	0.146	10	8	1147	0	6	14	0	0	15	0	97	0	0	121	0	11	86	13	4.23	0.70	5.87	0.11	0.95	0.06	N/R	0.16	
mainstem Layng Cr. below confluence with Junetta Cr. trib.	LC-33	0	8	—	0	199	0	0	19	16	20	5	0.071	11	7	1023	1	5	13	3	0	10	0	130	0	0	90	0	11	81	13	3.13	0.73	4.6	0.14	0.61	0.07	N/R	0.13	
lower reach Dinner Cr. trib. to Layng Cr.	LC-41	0	10	—	0	187	0	0	27	17	22	7	0.056	10	8	1247	1	9	9	4	0	13	0	140	0	0	157	0	11	99	15	3.4	0.73	5.75	0.14	0.62	0.05	N/R	0.27	
mainstem Layng Cr. at Rujada Campg.	LC-32a	0	9	—	0	172	0	0	21	18	20	6	0.052	11	7	989	0	6	13	3	0	10	0	112	0	0	108	0	11	84	13	3.04	0.87	4.9	0.09	0.61	0.05	N/R	0.16	
lower reach Prather Cr. trib. to Layng Cr.	LC-32b	0	6	—	0	191	0	0	28	29	46	9	0.060	8	9	1322	1	7	17	0	0	19	0	163	0	0	129	0	12	90	17	5.41	0.99	6.39	0.09	1.04	0.05	N/R	0.17	
mainstem Layng Cr. above confluence with Brice Cr.	LC-32	0	8	—	0	202	0	0	18	20	26	6	0.075	12	7	1073	1	5	12	3	0	11	0	134	0	0	103	0	13	89	11	3.35	0.71	4.92	0.15	0.64	0.08	N/R	0.14	
Row River																																								
mainstem Row River near confluence with Hunt Cr. trib.	RR-21	0	18	—	0.116	146	8	0.5	18	19	34	5	0.366	10	10	819	1	6	11	69	0	10	0	87	0	0	105	0	9	147	10	2.92	0.70	5.08	0.11	0.66	0.06	N/R	0.16	
mainstem Row River below Cedar Cr. trib.	RR-1	0	18	—	0.015	132	43	0.4	19	16	26	5	0.154	11	12	870	1	4	111	20	0	9	0	77	0	0	87	0	10	111	11	2.85	0.73	4.77	0.14	0.65	0.07	N/R	0.13	

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary
GEOLOGICAL SURVEY
W. C. Mendenhall, Director

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—

METALLIFEROUS MINERAL DEPOSITS OF THE
CASCADE RANGE IN OREGON

BY
EUGENE CALLAGHAN //
AND
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—
Prepared in cooperation with the
STATE MINING BOARD OF OREGON



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veal sufficient ore to justify a custom mill or, better still, a mill handling ore from several veins in the productive area as a unit operation. Probably some sulphide ore, particularly in the Bohemia district, is of high enough grade to bear shipment to a smelter, but no assays revealing such ore as blocked out were available to the writers. Sampling and further exploration may reveal ore shoots which, with the prices of precious metals prevailing in 1935 and with augmented prices for the base metals, may be attractive for profitable exploitation.

Small sulphide ore shoots are exposed in the North Santiam district, but so far as is known their precious-metal content is very low and their profitable exploitation will probably be obliged to await higher prices for base metals. No ore shoots containing appreciable sulphides were seen in the Quartzville district, though some small pockets of free gold ore near the surface undoubtedly remain. The proportion of sulphides in most of the veins in the Blue River district is very low, though streaks of sulphides are exposed over a length of several hundred feet in the lowest level of the Lucky Boy mine. The smaller mineralized areas probably cannot be depended on for any appreciable production, though one or more veins comparable to those already found may be discovered. In general, the Bohemia district has by far the best possibilities for future production of all the mineralized areas in the Cascade Range.

It is suggested for future prospecting and development that bodies of sulphide vein matter already revealed be carefully sampled and that, if the results warrant, further work be done to block out the ore. Additional prospecting might be done on veins known to have contained minable shoots of sulphide ores and on veins of demonstrated continuity in the productive area. Vein intersections are not necessarily highly mineralized but are nevertheless regarded as favorable areas for prospecting. Prospecting around the margins of the productive areas of the larger districts, particularly the Bohemia district, or in the smaller mineralized areas would be expected to reveal only minor amounts of sulphides, but it might result in finding small shoots or pockets of gold ore that may yield a profit if worked in a very small way with a minimum of overhead and investment.

MINERALIZED AREAS AND MINING DISTRICTS

BOHEMIA DISTRICT

The Bohemia district is described first because it is the most extensively developed, has had the largest production, furnishes the best examples and greatest variety of factors influencing mineraliza-

tion, and was studied in greater detail than the other districts. The remaining districts and mineralized areas are described in the order of their occurrence from north to south.

LOCATION AND ACCESSIBILITY

The Bohemia mining district is in Lane County, 35 miles southeast of Cottage Grove, largely within Tps. 22 and 23 S., Rs. 1 and 2 E. The productive part of the district is in one of the highest parts of the divide between the Willamette and Umpqua drainage systems. The district is larger than the area represented by the geologic map (pl. 13), as it includes a roughly circular area of about 60 square miles.

A good macadamized road follows the valley of the Row River from Cottage Grove to the mouth of Frank Brice Creek. Two mountain roads branch from this road, one following Frank Brice and Champion Creeks and the other following Sharps Creek; they join at the Bohemia district. According to F. S. Day the Champion road has been largely rebuilt and improved since 1931. A railroad connecting with the Southern Pacific line at Cottage Grove and extending to Rujada, near the mouth of Frank Brice Creek, is used for hauling logs and lumber, but it has never been extended to the Bohemia district. There are numerous trails through most of the district.

SURFACE FEATURES

The Bohemia district lies in a rugged, maturely dissected area in the Western Cascades. The most conspicuous feature is a group of sharp peaks rising 1,000 feet or so above the general summit of the range. (See pl. 2.) This group includes Bohemia Mountain, with an altitude of 5,987 feet; Fairview, 5,933 feet; Grouse, 5,570 feet; Grizzly, 5,450 feet; North Fairview, 5,550 feet; and Elephant, 5,522 feet. These mountains are the highest in the central part of the Western Cascades. The first four—Bohemia, Fairview, Grouse, and Grizzly—all lie on the ridge known as Calapooya Mountain, which divides the drainage basins of the Umpqua and Willamette Rivers. Narrow ridges and valleys radiate in all directions from the central part of the area, and steep forested slopes are characteristic. Glaciation has modified the upper parts of the valleys, particularly on northern and eastern slopes, and glacial debris extends down the valley of Champion Creek possibly as far as the mouth of Golden Curry Creek, or to an altitude of 3,100 feet. Glacial cirques, some of them with lakes and muskegs, are best represented by Crystal, Golden Curry, Champion, Horseheaven,

and Musick Basins. Some of the veins, particularly the Musick, have been eroded by glaciers. Possibly others have been covered by glacial debris, as in the vicinity of the old Champion mill.

GEOLOGY

GENERAL FEATURES

More than nine-tenths of the mapped area of the Bohemia district is underlain by a series of bedded volcanic rocks of Miocene (?) age, having a maximum thickness of 6,500 feet. These rocks comprise tuffs, volcanic breccias, and andesite lavas in about equal amounts, with minor lenses of coarse volcanic breccia and agglomerate and flows of rhyolite intercalated in the tuffs. The andesites range between very calcic and very sodic extremes, but the calcic type (labradorite or basaltic andesite) is the most characteristic of the district. There are many irregularities in the stratigraphic relations of the volcanic rocks, and all their characters are consistent with an origin through subaerial accumulation from volcanoes of the centric type. These rocks commonly dip at low angles to the northeast and east, although locally the dips vary, and some east-southeast dips were observed. Several dikes of andesite varying widely in strike traverse the bedded volcanic rocks and are presumed to be closely related to them. A considerable number of small plugs, dikes, and a stock of dioritic intrusive rocks occur in a belt extending northward through the central part of the area. They are included in an area of hornfels $3\frac{1}{2}$ miles long and half to three-quarters of a mile wide.

VOLCANIC ROCKS

Andesites, chiefly of the calcic or labradorite variety, make up the greater part of the ridge that includes Grouse Mountain and Noonday Ridge, as shown on plate 13. The high points in the western part of the area, including Bohemia, Fairview, Elephant, and Cat Mountains, are also characterized by labradorite andesite. Monte Rica Ridge, in the southwestern part of the area, contains about 700 feet of andesite.

A large lenticular mass of rhyolite occurs in the Sharps Creek Basin, on the west side of the area, and smaller masses occur in Champion Saddle; on the spur south of Crystal Creek; on the Johnson Meadows trail in sec. 8, T. 23 S., R. 2 E.; 500 feet south of the Golden Slipper tunnel on Horseheaven Creek, in sec. 20, T. 23 S., R. 2 E.; and on the Oregon-Colorado road in sec. 19, T. 23 S., R. 2 E.

The remainder of the area is made up chiefly of fragmental rocks—greenish tuffs, volcanic breccias, and agglomerate. Many flows of andesite, particularly of the light-gray andesine-bearing variety, are

included. The andesite rocks are particularly prominent on the west slope of South Grouse Mountain and on Jackass Butte. Coarse volcanic breccia occurs at several places, including the band above the Oregon-Colorado mine, at the Mayflower mill on Horseheaven Creek, in the bed of Champion Creek a short distance above the mouth of Cat Creek, and in crosscut 9 of the Champion mine, where the material has a rude cross-bedding. A somewhat different breccia or agglomerate constitutes the whole ridge top between Fairview Peak and North Fairview Mountain. The smaller fragments are about $1\frac{1}{2}$ inches and the larger fragments several inches in diameter. Some of the andesite of the fragments is massive, and some is highly amygdular. There is very little difference between fragment and groundmass, and the aggregate weathers uniformly and breaks smoothly. It forms a lens between flows and may be a flow breccia.

As the whole series of volcanic rocks dips mainly to the east or northeast, the series is believed to be essentially conformable, possibly except the flows of Bohemia Mountain, with the oldest rocks at the southwest side of the area and the youngest at the east. The stratigraphic relations of the rock groups that crop out along the lines represented by A-A' and B-B', plate 13, are shown in the sections on the same plate.

Local unconformities occur at various places, but they probably have no great significance. The seven upper flows of the series forming Bohemia Mountain are in conformable sequence without intercalated tuff, but the two lower flows interfinger with tuff and do not appear on the south side of the mountain, suggesting a possible unconformity. An erosional unconformity appears on the southwest side of Grouse Mountain, where beds of tuff and a small fault are cut off on the erosion surface beneath a succession of flows.

DIORITIC INTRUSIVE ROCKS

Numerous small bodies of dioritic intrusive rocks occur in the Bohemia district, and 26 different bodies ranging from thin dikes to cylindrical plugs and a small stock are shown on the geologic map (pl. 13). Doubtless some bodies, obscured by the forest litter, have been overlooked. These rocks are most prominent in a belt extending in a northeasterly to northerly direction from the south end of Bohemia Mountain through Champion Saddle and down the valley of Champion Creek. Several appear on Noonday Ridge. Elongate bodies trend chiefly to the west or northwest except for the stock in the valley of Champion Creek, which is elongate in a northerly direction. Most of the plugs are less than 250 feet wide, most of the large dikes are less than 600 feet wide, and the stock on

Champion Creek is about $1\frac{1}{4}$ miles long and about 2,000 feet wide. Most of the dikes are less than a mile long.

The intrusive rocks are medium to light gray, porphyritic, and variable in texture and composition, though characterized chiefly by augite. The stock and the large dikes consist chiefly of granodiorite or granodiorite porphyry, some of the small plugs are diorite or diorite porphyry, but most of the small plugs and dikes are dacite porphyry. A large part of the workings of the Champion, Helena, and Leroy mines are in the intrusive rocks. The body at the south side of the area mapped is a porphyritic rhyolite and is not definitely related to the group of dioritic intrusives.

CONTACT-METAMORPHIC ROCKS

The volcanic rocks near all the dioritic intrusive bodies have been modified to some extent by the heat and solutions given off by the intrusive mass. In addition to the narrow zones or aureoles of contact-metamorphic rock around the small isolated intrusive bodies, there is a large continuous zone of contact-metamorphic rock extending from City Creek southwest of Champion Saddle northward to the Cape Horn vein, a distance of $3\frac{1}{2}$ miles.

The contact-metamorphic rocks, called hornfels, range from those which are only slightly modified to those in which the original minerals and structure are obliterated. Tourmaline hornfels, which represents the most intense degree of metamorphism, occurs in the vicinity of the Champion mine and particularly on the north side of the dike west of the United States mineral monument. Rugged outcrops of hornfels occur along the valley of Champion Creek, particularly along the west side of the stock and on to the northwest for half a mile downstream beyond the stock. The group of veins in the vicinity of the Champion mine and the old Champion mill and the Cape Horn vein are the only prominent veins lying partly or wholly within the large zone of contact-metamorphic rock.

STRUCTURE

A gentle regional deformation has affected the volcanic rocks, which dip prevailingly to the northeast. (See pl. 13.) The most notable variations are along Champion Creek, where the dip is north to north-northeast, and in the area south of Grouse Mountain and east of Champion and City Creeks, where the dip is mainly east-northeast, changing to east for 2 miles north of Champion Saddle and resuming the northeasterly direction farther north. There are southeasterly dips in some places. The steepest dips for any considerable area were observed in the vicinity of Fairview Mountain, where the contact between the lavas and tuffs underlying the northeast spur of the mountain dips about 30° NE. North of Crystal

Basin the angle of dip is smaller than that of the surface. Diller⁶⁵ has suggested that the Bohemia district is on the limb of an anticline, but the prevailing easterly or northeasterly dip continues as far south as the writers' investigation extended, and the axis of such an anticline must therefore be well outside the district. The flows forming the caps of Bohemia, Elephant, and Cat Mountains dip at low angles to the east or northeast. The average dip of the lavas in Noonday Ridge and Grouse Mountain was not ascertained, but dips of 20° or less are inferred in the sections. The tuffs east of Horseheaven Creek also dip to the east at low angles.

Faults are not abundant, so far as could be ascertained. The most prominent fault is that along the Crystal vein, which strikes N. 70° W. and dips 56° S. In the saddle between North Fairview and Elephant Mountains the vertical component of the displacement amounts to about 200 feet, but the presence of horizontal striations leaves the actual direction and amount of displacement in doubt. Faulting is indicated along the fracture of the Yucon vein, which strikes about N. 80° W. through the narrow gap in the north spur of Bohemia Mountain. It is followed for about 350 feet by the Musick vein, and there may be that much displacement of the original Musick fracture. A slight displacement was also noted along the Yellow Jacket vein. The walls of many of the veins show slickensides and striations, but because of the lack of marker beds no measurement of the displacement could be made. The striations on the walls of the veins are usually more nearly horizontal than vertical.

The major structural axis of the area is the curving line through the center of the district, trending north-northwest in the north and southwest in the south. It largely marks the change of strike of the volcanic rocks from the northeast to east, and also coincides with the belt of intrusive and contact-metamorphic rocks. The trend of the large stock is parallel to this axis, but the smaller elongate bodies trend west or northwest.

By far the greater part of the joints in the western part of the area strike N. 60° – 90° W. and dip 70° – 90° S., but lower and northerly dips occur in some places. There are two minor joint systems, one with a strike of N. 20° – 40° W. and the other with a strike of N. 20° – 40° E. Some joints striking in other directions were found. On the east spur of North Grouse Mountain, and farther northeast there are two sets of joints, one striking N. 45° – 70° E. and dipping 60° – 80° NW. and the other striking N. 75° – 90° W. and dipping 50° – 90° N., with a minor set striking N. 20° – 40° W. A set of joints

⁶⁵ Diller, J. S., The Bohemia mining region of western Oregon, with notes on the Blue River mining region and on the structure and age of the Cascade Range: U. S. Geol. Survey 20th Ann. Rept., pt. 3, p. 10, 1900.

north of the Mayflower claims strikes N. 50°-65° W. and dips 70°-90° NE. In general there is a set of joints within 20° of the direction of dip of the beds.

The veins likewise have a dominant trend to the northwest and west. About half of them strike N. 50°-70° W., about a quarter N. 70°-90° W., and the remainder N. 30°-50° W. Dips are mainly 60°-80° S. Most of the veins with a northwesterly strike are in the southern half of the area, and those with a westerly strike are in the northern part.

MINERAL DEPOSITS

GENERAL FEATURES

Though the Bohemia district covers a roughly circular area of about 60 square miles, the main mineralized belt occupies an area 5½ miles long and 1½ miles wide trending N. 60° W. It includes the Mayflower, Riverside, and Oregon-Colorado mines at the south-east and the Utopia, Sweepstakes, and Musick at the northwest. Gold has been the principal ore mined and has been obtained largely from the oxidized parts of sulphide veins. The veins are younger than any of the other rocks in the district, including the intrusive bodies. The vein matter in most places consists of brecciated, altered, and partly replaced country rock cemented by or containing fissure fillings of drusy or comb quartz that locally contains sulphides. In some veins there are bodies of cherty quartz with pyrite crusts along intersecting short fractures. The dominant sulphide, sphalerite, is associated with galena, chalcopryite, and pyrite in varying amounts, and in some places with a little tetrahedrite. Galena is the dominant sulphide in the Musick vein, chalcopryite in the Oregon-Colorado, and stibnite in the Tall Timber. Primary specularite is associated with quartz in several of the veins. The gold content of the unweathered sulphide ores is low in most places, though a few high-grade pockets have been found. There is a rough areal zonal distribution of mineral deposits in relation to intrusive rocks. Base-metal quartz shoots with variable amounts of gold and in places with specularite and dolomite are grouped in the area of most intensive igneous intrusion; and veins with generally less sulphide, more carbonate (commonly calcite), and in places stibnite occur in an area to the south, where there are fewer intrusive bodies.

HISTORY AND PRODUCTION

Diller⁶⁶ gives the following account of the early history of the region:

⁶⁶ Diller, J. S., op. cit. (20th Ann. Rept., pt. 3), p. 7.

The Bohemia mining region was discovered, according to Dr. W. W. Oglesby, of Junction City, Oreg., by himself and Frank Brass [Brice?] in August 1858. The region was named for James Johnson, also called Bohemia Johnson, who, with George Ramsey, reached it in 1863 from Roseburg by way of the North Fork of Umpqua River and Steamboat and City Creeks. Free gold was found in a small vein near the headwaters of City Creek but gave out at a depth of 6 feet. Bird Farrier discovered what, by purchase, became later the Knott claim, where a 5-stamp mill was put up in 1875. It shut down in 1877, and the Bohemia region was almost forgotten until interest in it was revived by Dr. W. W. Oglesby, O. P. Adams, and others in 1891. The first ledge of importance located the same year, was the Musick, which has been running a 5-stamp mill almost continuously ever since. In 1892 the Annie (since called the Noonday) was opened. The Champion put in a 10-stamp mill in 1895 and the Noonday a 20-stamp mill in 1896. Over a hundred claims have been located in the district.

In 1902 operation of the Champion, Helena, and Musick mines was consolidated under the West Coast Mines Co., and a 30-stamp mill was erected at the Champion mine. Kimball⁶⁷ reports that in 1902 there were—

not less than 2,000 mining claims of record, some of which, as may be assumed, are fractional and some relocations. * * * The district numbers about 60 head of stamps.

The Noonday mine was productive between 1896 and 1908, when it was closed down. MacDonald⁶⁸ states that in 1908 no ore was being milled in the district, nor had any milling been done since the preceding summer. In 1912 the combined Champion, Helena, and Musick mines were shut down. W. W. Elmer⁶⁹ states that from 1912 to 1918 the Champion was held under lease and bond by two operators who did a little development work and mining but ceased operations in 1917. Development and some mining was carried on by the Vesuvius Mines Co. for several years prior to 1921. The Evening Star mine, on the eastern part of the Champion vein, has been worked in a small way in recent years on oxidized ores. In the summer of 1930 there was no mining and only sufficient prospecting to satisfy the requirements of assessment work.

Within the area shown on the map (pl. 13) there are 78 patented claims and 59 claims surveyed for patent. To the west of this area, in the vicinity of Glenwood and Mineral and farther south, there are 30 claims surveyed for patent. About 200 adits and 75 veins are shown on the map (pl. 13).

The recorded production of the district is given in the table below. Undoubtedly metal was produced that was not recorded, especially in

⁶⁷ Kimball, J. P., Bohemia mining district of western Oregon: Eng. and Min. Jour., vol. 73, p. 889, 1902.

⁶⁸ MacDonald, D. F., Notes on the Bohemia mining district, Oreg.: U. S. Geol. Survey Bull. 380, p. 83, 1909.

⁶⁹ Elmer, W. W., private report.

the earlier years and some of the mines that are known to have produced are not mentioned in the records. Consequently the total production very probably exceeds the figure given, but not by any very large amount.

Output of gold and silver in Lane County, 1880-1900¹

[From records of United States Mint]

Year	Gold (ounces)	Silver	Year	Gold (ounces)	Silver
1880.....	131.87	-----	1892.....	1,523.81	\$247.50
1881.....	181.41	-----	1893.....	2,757.37	-----
1882.....	-----	-----	1894.....	1,572.19	-----
1883.....	-----	-----	1895.....	1,647.80	29.51
1884.....	-----	-----	1896.....	2,709.00	-----
1885.....	-----	-----	1897.....	117.99	10.47
1886.....	145.13	-----	1898.....	-----	-----
1887.....	241.88	-----	1899.....	2,015.01	1,131.31
1888.....	241.88	-----	1900.....	-----	-----
1889.....	169.31	-----	Total.....	14,590.96	1,418.79
1890.....	145.13	-----			
1891.....	991.18	-----			

¹ Probably almost entirely from Bohemia district.

² No record.

³ Small production.

Output of metals in the Bohemia district, 1901-30

[From data supplied by V. C. Helkes]

Year	Crude ore (tons)	Concentrates (tons)	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)
1901 ¹	-----	-----	-----	-----	-----	-----
1902.....	420	-----	167.10	-----	-----	-----
1903.....	1,000	-----	290.25	-----	-----	-----
1904.....	-----	-----	-----	-----	-----	-----
1905.....	6,100	-----	2,231.92	1,024	-----	-----
1906.....	6,000	-----	2,633.73	1,049	-----	-----
1907.....	7,647	134	1,816.92	727	-----	-----
1908.....	26	-----	42.38	143	629	2,138
1909.....	2,312	-----	648.85	349	-----	-----
1910.....	1,337	-----	213.10	73	-----	-----
1911.....	4,650	8	1,465.48	451	-----	-----
1912.....	8,104	120	2,465.19	1,681	5,098	35,785
1913.....	1,375	118	290.11	1,604	7,308	59,204
1914.....	631	-----	158.08	29	406	5,979
1915.....	2,142	73	470.11	128	1,390	16,348
1916.....	49	-----	159.98	328	-----	-----
1917.....	24	-----	95.93	88	-----	-----
1918.....	15	-----	46.01	-----	-----	1,362
1919.....	-----	-----	-----	-----	-----	-----
1920.....	-----	-----	-----	-----	-----	-----
1921.....	20	-----	42.96	229	-----	-----
1922.....	Silice	-----	25.44	6	-----	-----
1923.....	200	-----	94.88	44	-----	-----
1924.....	100	-----	97.06	46	-----	-----
1925.....	78	-----	63.48	29	-----	-----
1926.....	178	-----	61.93	27	-----	-----
1927.....	-----	-----	-----	-----	-----	-----
1928.....	100	-----	63.75	29	-----	-----
1929.....	15	-----	7.04	3	-----	-----
1930.....	25	-----	11.96	4	-----	-----
Total.....	42,548	453	13,004.59	8,148	14,831	120,816

¹ No record.

NOTE.—Approximate values, 1880-1930: Gold (at \$20.67 per fine ounce), \$584,662; silver, \$6,473; copper \$2,480; lead, \$5,775; total, \$599,390.

The value per ton in terms of recovered metals for outputs of 100 tons or more for the various mines since 1902 has ranged from \$1.20 to \$16 (with gold figured at \$20.67 an ounce), as deduced from data of V. C. Helkes, of the United States Bureau of Mines. The value per ton for small shipments of sorted ore has been as much as \$100 or more. The average value per ton for the largest operation, that of the combined Musick and Champion mines, was \$6.90 for 14 years. Annual averages for years in which more than 1,000 tons was milled range from slightly less than \$5 to slightly more than \$9 a ton (\$20.67 an ounce for gold). Zinc was a liability rather than an asset in these complex ores during the years when concentrates were produced, and the price of lead was high only in 1916-18, when there was base-metal production. No data on costs during the productive years are available, but the obvious difficulties of transportation and the cost of mining relatively small ore shoots must have made the cost per ton relatively high. From the scanty data available it seems unlikely that the original cost of the elaborate plant and equipment of the largest company was amortized.

CLASSIFICATION

Base-metal veins with variable amounts of gold.—Most of the production has come from the base-metal veins, of which the Champion, Helena, Musick, Noonday, Vesuvius, Crystal, Grizzly, Shotgun, Utopian, Vindicator, and War Eagle are examples. The features of this type of vein have been described in the general descriptive part of this report (pp. 24-29). The metal content of the sulphide ore shoots is highly variable. Such assays of minable shoots as are available indicate that most of the gold ranges from a trace to slightly more than 1 ounce to the ton, with an average of about 0.4 ounce. Most of the silver ranges from a trace to 4 ounces to the ton, with an average of about 2 ounces. Copper ranges between a trace and 1.5 percent and averages 0.75 percent. Lead ranges from a trace to 6 percent, with an average of about 3 percent; and zinc ranges from 1 to 14 percent, with an average of about 5 percent. Variations occur in the proportions of the various minerals in the base-metal veins, and some, such as the Cross vein, of the War Eagle group, a vein of the Orofino group, the Alpharetta vein, and shoots on the Sultana and Cape Horn veins, contain abundant specularite. The California vein contains johannsenite.

Veins of quartz and clay minerals.—The veins containing quartz and clay minerals consist of kaolinized and silicified country rock with sparse to abundant seams and lenses of quartz that in some places contain a little sulphide. Examples of such veins include some near the west border of the granodiorite stock along Champion

Creek and the North Fairview and Syndicate veins. They have not been productive.

Pyrite and cherty quartz veins.—Parts of the Sultana, Cape Horn, and Orofino veins, the northern vein east of Helena No. 2 camp, and the Golden Slipper vein are made up of cherty quartz with many small fractures faced with pyrite containing some intergrown marcasite.

Chalcopyrite-quartz veins.—The only example of the chalcopyrite-quartz veins is the Oregon-Colorado vein, which is described on pages 72-73.

Gold-quartz and gold-calcite-quartz veins.—Low-grade gold-quartz veins occur in the western part of the district, outside the mapped area. At the Star mine the ore consists of white massive and vuggy quartz with calcite and pyrite. Sphalerite, chalcopyrite, and galena are present in some veins in minor amounts. A shoot on the Western vein of the Cripple Creek group consists of massive quartz with very sparse sulphide and some coarse gold. Calcite is the major gangue mineral in the El Capitan vein on St. Peters Creek, where it is associated with sulphides, principally galena, and comb quartz.

Stibnite-pyrite-quartz veins.—Stibnite veins are represented by one of the veins of the Tall Timber group described on page 78.

Specularite and magnetite veinlets and disseminated specularite.—Fractures in hornfels adjacent to many of the intrusive bodies contain specularite and magnetite. Specularite and pyrite are disseminated in bleached zones of andesite or tuff near intrusive masses.

Disseminated pyrite.—Pyrite is disseminated in the contact zones around the smaller intrusive bodies and in the outer part of the large areas of contact-metamorphic rock.

ZONAL ARRANGEMENT

No evidence of vertical zoning and only poorly defined evidence of areal zoning of sulphide minerals has been found. Veins with sulphides have a vertical range of 2,800 feet, though the maximum depth within any single mine is only about 400 feet, but sulphides persist through this range without any apparent change.

A rough areal zoning is indicated in the principal mineralized belt, which extends west-northwestward from the Mayflower to the Utopia. This belt is characterized by shoots in which the gold content is variable and the chief sulphides are sphalerite, galena, and pyrite, with subordinate amounts of chalcopyrite, in a gangue of quartz, sericite, clay minerals, and a little dolomite in vugs. In the center of this belt, in the vicinity of the Champion mine and the area of large intrusive bodies and extensive contact metamorphism,

primary specularite is associated with quartz in several veins, and metamorphic rock nearby contains tourmaline. Vein matter in the Grizzly, Cape Horn, and Sultana veins, farther north, is similar.

Farther south and southwest there are fewer intrusive bodies, fewer veins, and fewer shoots that contain noteworthy proportions of sulphides. Sphalerite and galena are less abundant. Stibnite occurs at the south end of the Western vein and in the El Capitan and Tall Timber veins and is reported to occur in veins in the vicinity of Twin Rocks, farther southwest. Carbonates are common in some of the veins in this area. Dolomite forms considerable bodies in the Western vein, and calcite is abundant in the El Capitan vein. Sulphides are sparse in the Glenwood and Combination veins and at the Star mine. All these characters are consistent with mineralization at lower temperatures than those in the area to the north and northeast.

HYDROTHERMAL AND SUPERGENE ALTERATION OF WALL ROCK

The wall rocks of all the veins have been altered and new minerals have been formed. Several veins, such as the Oregon-Colorado, are accompanied by altered rock characterized by chlorite. In these the rock is greenish and superficially appears fresh, though the microscope shows that original minerals are partly or completely destroyed. Large areas of altered rock that is bleached and iron-stained at the surface occur in Champion Saddle, in Bohemia Saddle, in the saddle between Fairview and North Fairview Mountains, in the saddle between North Fairview and Elephant Mountains, in Grizzly or Helena Saddle, in the saddle in the eastern part of sec. 7, T. 23 S., R. 2 E., in the western part of sec. 8, T. 23 S., R. 2 E., on Monte Rica Ridge, in sec. 23, T. 23 S., R. 1 E., and on the south and west slopes of Jackass Butte. Similar altered rock occurs in the vicinity of the Knott shafts, in the saddle between North Grouse and South Grouse Mountains, and in the western part of the district, outside the area represented by the geologic map. Smaller areas accompany many of the veins throughout the district. The bleached altered rock is characterized in outcrop by its light color (white or various tints of yellow), craggy or pitted weathered surface, and low resistance to weathering and erosion, hence its occurrence in saddles and other relatively low places. Samples collected from the Champion workings and discussed on pages 31-32 are made up largely of very fine grained quartz, abundant pyrite, a little sericite, and abundant clay minerals. Some of the clayey material tends to slough in underground workings. Thoroughly weathered material contains no pyrite but is iron-stained.

FUTURE OF THE DISTRICT

By its recorded production of nearly \$600,000, the Bohemia district has proved itself worthy of consideration, though this output is small as compared with that of many other mining camps or with that of the placer operations in northeastern and southwestern Oregon. The output has come chiefly from the weathered parts of the veins, and probably all but a small part of the free-milling ore has been removed. Though the district has been extensively prospected, it is possible that other veins with oxidized free-milling ore shoots will be found in an area so densely covered with forests and forest litter. Shoots or parts of shoots of sulphide ore remain in the principal mines, and bodies of sulphide vein matter have been partly explored in some of the prospects. Many of the veins as a whole, as distinguished from ore shoots, have been shown to be persistent over lengths of more than half a mile, and some contain several ore shoots. The fact that the difference in altitude between the lowest and highest veins within the productive part of the district is 2,800 feet is encouraging for deeper exploration on the larger veins. It may be expected that sulphide ores will persist to depths of several hundred feet at least in the large veins, though there are no data on which to base predictions of possible metal content of the ore. The veins outside of the main productive area previously outlined may be expected to include shoots containing some gold but very little sulphide ore, and they should be worked in only a very small way with a minimum of overhead.

The gold and silver content of the sulphide ore is low in most places, but the sulphides are doubtless amenable to flotation, a process that has not been tried in this district. No sufficiently large shoots of ore were blocked out in 1930 to justify installation of a modern flotation mill at any one of the mines. Further exploration and development of several of the veins should, however, reveal sufficient ore to justify a custom mill. Unit operation of several of the mines in the central part of the district might be a profitable enterprise, but the margin of profit in any large operation will undoubtedly be small, because of the low gold and silver content of the sulphide ores and the high costs of transportation. However, improved transportation facilities now available and modern equipment designed to yield a large proportion of the metals in the ore should tend to offset the advantage of higher grade of ore enjoyed by the earlier producers. Favorable prices for the base metals together with the prices of precious metals prevailing in 1935 should make some of the veins attractive for exploitation. Operations should proceed with a minimum of overhead until the amount and grade of the ore are established.

MINES AND PROSPECTS

The mines that have made noteworthy production—Champion and Evening Star, Helena, Musick, Noonday, and Vesuvius—are described first, and the other veins and properties are described in alphabetical order.

Champion and Evening Star.—The Champion group comprises 10 claims lying in and near the head of the Champion Creek Basin. The mine is on the narrow ridge between the Champion Creek and City Creek Basins at Champion Saddle. Operations were carried on from the Champion Creek side, so that all buildings and tunnel portals are on that side. The Evening Star mine is on what is regarded as the southeasterly extension of the Champion vein, and the crosscut tunnel portal and mill are on the City Creek side. The property has been known as the Hartford mine of the Calapooia Mining & Tunnel Co. and was formerly one of the properties of the West Coast Mines Co.

The recorded production up to 1930 was about \$291,500, including the value of small amounts of lead and copper. An unknown part of this production should be credited to the Musick mine, as ore from both mines was milled together for several years. The period of maximum production appears to have been 1900 to 1913.

A boarding house, bunkhouse, office, and tunnel house at level 12 are located in the Champion Creek Basin. There is a cabin and mill at the Evening Star.

The Champion and Evening Star veins have been developed by drifts on five levels for a distance of about 1,600 feet along the strike. The total length of workings, crosscuts, drifts, and raises is about 10,000 feet (fig. 1), of which a part is now inaccessible. The lowest level, no. 9, is reached from the north by a large haulage tunnel 950 feet long and was connected to all other levels by raises. Level 6 is reached from the south by a crosscut 210 feet long at the Evening Star (fig. 1). Crosscut 12 was started at the foot of the slope at the head of the Champion Creek Basin and advanced 420 feet S. 10° E. It is estimated that the Champion vein will be intersected about 460 feet farther in and about 320 feet below level 9.

The Champion vein traverses rhyolite, labradorite andesite, tuff, hornfels, and granodiorite porphyry. The average strike of the vein in the Champion workings is N. 65° W., though it ranges from N. 45° W. to N. 80° W. In the Evening Star workings the strike is N. 60° W. The average dip is 65°–70° S., though the dip is as low as 60° on level 5 and as high as 80° on level 9. The vein matter consists of sphalerite, pyrite, chalcopyrite, galena, and a little hematite in quartz and altered rock. Oxidation is nearly complete near the surface, and there is some oxidation throughout the workings.

A tunnel 100 feet long, following a vein S. 51° E., is about 400 feet southeast of the vein described above, at an altitude of about 4,700 feet. A quartz stringer dipping 70° S. and containing seams of sphalerite and pyrite is exposed in the tunnel, which is in tuff.

On the road to the Helena mine some 500 feet north of the mine are two short drifts on zones of altered rock. The one nearer the mine trends N. 60° W.

Musick.—The Musick group comprises 16 claims, of which 13 are surveyed for patent. The claims lie mostly in the valley of City Creek but extend across the divide into the basin of Sharps Creek. The Musick mine is the principal working and is at the head of City Creek in the Bohemia Saddle, on the north slope of Bohemia Mountain. The mine is accessible by automobile from either the Sharps Creek or Champion Creek road. A boarding house, bunkhouse, cabins, and mill house are located on the property.

According to Diller⁷² the Musick vein was discovered in 1891 and was worked almost continuously till 1898 and possibly later. In 1902 the Musick property was consolidated with the Champion and Helena under the West Coast Mines Co., and the ore was hauled by electric locomotive to the Champion mine and milled at the Champion mill. However, most of the work appears to have been done prior to 1903.

The recorded production is nearly \$100,000, but an additional unknown part of that credited to the Champion area came from the Musick.

The mine is developed by some 4,900 feet of drifts and crosscuts, which were accessible at the time of the examination, and numerous stopes, raises, and winzes. Three main levels about 100 feet apart explore the vein for nearly 1,800 feet. The upper level, no. 2, goes all the way through the mountain and is accessible by a short crosscut at the west or Sharps Creek end. Level 4 (fig. 2) and level 6 are reached by crosscuts from the east or City Creek slope. Level 6, though not so long as the other two, is the haulage level, and the crosscut leads directly to the mill house and the tramway that formerly extended to the Champion mine.

The Musick vein differs from most other veins in the district by having sharp bends in its course. (See fig. 2.) At the east end of level 4 the strike is N. 55° W. for a short distance, then nearly west for 300 feet, then N. 42° W. for 600 feet, then west for 500 feet. The dip ranges between 65° S. and vertical, but in most places it is 70°–80° S. The country rock is light-colored rhyolite except a few exposures of andesite and tuff in the eastern part of levels 2 and 4.

⁷² Diller, J. S., op. cit. (20th Ann. Rept., pt. 3), p. 7.

The vein matter consists chiefly of the usual sulphide assemblage and quartz but differs from that in other veins in having a distinctly higher proportion of galena. The upper 100 feet of the vein, especially at the west end, is almost completely weathered, and some weathered material extends to level 6. Several splits in the vein enclose lenses of country rock.

The ore shoots are arranged as shown in the longitudinal section (pl. 15). Shoot A has been stoped for a horizontal distance of 300 feet and for widths of 2 to 6 feet above level 4. It extends down to level 6 as two roots enclosing a lens of very low grade vein matter. The two parts extending down to level 6 are 2 to 7 feet wide and are stoped for horizontal distances of 50 to 75 feet. According to engi-

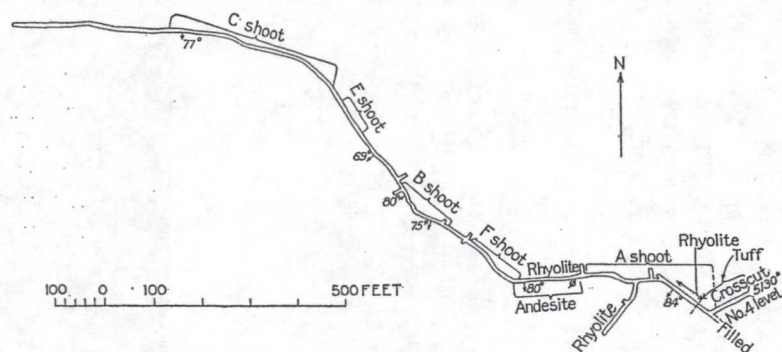


FIGURE 2.—Sketch map of level 4 of Musick mine, Bohemia district. From pace and compass traverse.

neers' reports, two samples from the floor of level 6 in the westernmost stope assayed about 0.24 ounce in gold and 2 ounces of silver to the ton, 8 percent of lead, 1 percent of copper, and 4 percent of zinc, for an average width of 3.2 feet. A sample of weathered ore in a pillar above level 4 assayed 1.40 ounce of gold and 2 ounces of silver to the ton and 2.3 percent of lead. Samples from 80 feet of drift east of the easternmost stope on level 6 averaged about 0.07 ounce of gold and 1 ounce of silver to the ton, 2 percent of lead, 2 percent of zinc, and 0.2 percent of copper for an average width of 5 feet.

Shoot B is stoped for a horizontal length of 375 feet above level 2 and for 160 feet between levels 2 and 4. Most of the stopes are 3 to 5 feet wide. Two samples of partly weathered ore from pillars above level 4 assayed 1.98 ounces and 0.9 ounce of gold and 2 and 2.4 ounces of silver to the ton, 1 and 3.7 percent of lead, a trace of copper, and 5.7 and 8.9 percent of zinc for widths of 1 foot and 3.7 feet, respectively. Samples taken along level 4 for 125 feet west of

shoot B assayed 0.1 to 0.2 ounce of gold and $1\frac{1}{2}$ to 2 ounces of silver to the ton, 5 percent of lead, 0.5 percent of copper, and 5 to 6 percent of zinc for widths between 2 and 5 feet. A tongue of ore about 40 feet in horizontal length extends below level 4 west of the raise below shoot B. A little sulphide occurs in this tongue, which is 3 feet wide below shoot B.

Shoot F is separated from shoot B by a pinch of the vein. It is partly stoped above levels 2 and 4 and has a horizontal length of about 150 feet on level 4. According to engineers' reports, samples from the back of the stope above level 4 assayed 0.24 to 0.96 ounce of gold and 1 to 3 ounces of silver to the ton, 2 to 6 percent of lead, a trace to 1 percent of copper, and about 7 percent of zinc for an average width of 1.4 feet. This vein matter consists of seams of solid sulphide 6 to 10 inches wide and altered rock. Shoot F has a length of a little over 200 feet on level 6. Samples from the west half assayed about 0.34 ounce of gold and 3 ounces of silver to the ton, 6 percent of lead, $1\frac{1}{2}$ percent of copper, and 7 percent of zinc for an average width of 2.6 feet. Samples from the east half assayed 0.20 to 0.48 ounce of gold and 2 ounces of silver to the ton, 3 percent of lead, 1 percent of copper, and $4\frac{1}{2}$ percent of zinc for an average width of 2.8 feet.

Shoots D and E may be parts of a single ore shoot, though barren vein matter lies between the two stopes. The stope on shoot D is 3 to 4 feet wide. The vein between shoots D and C assayed only a trace of gold. Shoot E on level 4 is about 75 feet in horizontal length. Samples at the east end assayed about 0.63 to 0.68 ounce of gold and 2 ounces of silver to the ton, 6 percent of lead, 0.5 percent of copper, and 5 percent of zinc for an average width of 3.4 feet.

Shoot C has been stoped from level 4 to a point near the surface. It has a horizontal length of 175 feet on level 2 and about 250 feet on level 4. The width is mostly 4 to 6 feet. A stope 30 feet wide and 10 to 15 feet high lies 100 feet west of shoot C on level 2. The vein matter here is completely oxidized and contains much oxide of manganese. This is regarded as the combined Musick and California veins. Samples near the west end of level 2 assayed about 0.15 ounce of gold and 1 ounce of silver to the ton, 0.1 to 0.3 percent of copper, and a trace of lead and zinc for an average width of 5.5 feet.

The California vein lies north of the Musick vein but intersects it on the west side of the ridge at an angle of about 15° . It has been proved for a length of more than 1,500 feet at the surface by several prospect pits, a shaft at an altitude of 5,250 feet, and two drifts at altitudes of 5,120 and 4,970 feet. The probable intersection with the Musick vein is exposed on levels 2 and 4 of the Musick mine. The

drift at an altitude of 5,120 feet is 300 feet long. The country rock is light-colored rhyolite except at the east end of the vein, where it is tuff. The vein is 5 to 12 feet wide and consists of brecciated rhyolite and quartz. The quartz contains some sulphides and some seams of johannsenite, which weathers to brownish-black oxides of manganese.

The Mystery vein is on the Mystery claim, in the east-central part of sec. 14, T. 23 S., R. 1 E. It has been prospected by a shallow shaft, shallow pits or trenches, and a short cross-cut tunnel running S. 35° E. for 30 feet. The country rock is hornfels; some of it is tourmaline-bearing, which indicates that it is part of the contact-metamorphic aureole of the intrusive plug that lies north of the vein. The vein strikes N. 75°–80° W. and dips 80° S. It consists of a band of quartz 1½ feet wide that contains knots of clay minerals, some disseminated specularite, and a little chalcopryite, sphalerite, galena, and pyrite. According to Diller⁷³ one sample containing much micaceous red hematite and a trace of galena assayed 1.95 ounces of gold and 7.25 ounces of silver to the ton, 0.16 percent of lead, and a trace of copper. Another assay yielded 0.05 ounce of gold and 1.30 ounces of silver to the ton, 5.57 percent of zinc, and 2.27 percent of lead.

The Alpharetta vein is on the Alpharetta claim, near the east side of sec. 14, T. 23 S., R. 1 E. It has been prospected by two drifts on Alpharetta Creek at altitudes of 4,310 and 4,410 feet. The lower drift follows the vein, which dips 50°–70° SW., for about 175 feet N. 52°–61° W. The country rock is andesite. A 3-foot band of quartz occurs in one part of the drift, but this band is only about 8 inches wide in the footwall part of the vein at the face. The vein matter contains only a little specularite, sphalerite, chalcopryite, pyrite, and galena with a little dolomite, though there are a few seams of abundant sulphides. The upper drift follows the vein, which dips 70° SW., for 100 feet N. 65°–80° W. A seam of quartz is exposed at the face of the drift.

An adit 60 feet long, generally known as the Cline, has been driven on a vein on the north side of Alpharetta Creek about 600 feet east of the Alpharetta. The vein strikes N. 40° W. and dips 80° SW. It consists in part of a well-defined quartz vein with altered rock and in part of a fracture zone in tuff with a few reticulating quartz veinlets. The quartz contains a little sphalerite, chalcopryite, pyrite, and galena and is associated with considerable ankerite.

Noonday.—Five patented claims and one unpatented claim constitute the Noonday group, which is in sec. 18, T. 23 S., R. 2 E., on

⁷³ Diller, J. S., op. cit. (20th Ann. Rept., pt. 3), p. 24.

the east slope of Grouse Mountain and the south rim of Horseheaven Basin. Three veins—the Henry, Maggie, and Annie—are included in the property; the Annie vein is the one on which the Noonday mine is located.

According to Diller⁷⁴ the Noonday mine was first opened in 1892, though it is credited with production for 1891. It appears to have been operated until 1908, when it changed hands. A new mill was built in Horseheaven Basin, and an aerial tram constructed, but the ore remaining was not free-milling, so the mine was closed. Some small shipments were made in 1917 and 1918. The recorded production for 1891–96 and 1918 is almost \$96,000. Possibly this may also include production from the Helena.

The mine was largely inaccessible at the time of the writers' visit. It has been developed on three levels. Level 1 is on the Noonday road at an altitude of about 5,350 feet, level 2 is 100 feet below level 1, and level 3 is 180 feet below level 2. In 1898 Diller⁷⁵ estimated a total of 2,000 feet of workings. Level 1 is near the surface, and the outcrop of the vein is marked by caved stopes. Level 2 is accessible by a crosscut running S. 44° W. to drifts running N. 55°–60° W. Level 3 is reached by a crosscut running 400 feet S. 50° W. to a drift that runs N. 70° W. for about 370 feet. A crosscut extends south from the drift at a point 270 feet from the main crosscut. It is 225 feet long and was driven to intersect the Maggie vein, which it lacks some 50 or 75 feet of reaching. Two short drifts, one caved, explore the vein southeast of the mine, and a crosscut 100 feet long, which did not penetrate the vein, lies to the extreme southeast.

The vein is prospected for about 1,300 feet and trends N. 45°–70° W. The dip ranges from 75° N. to 85° S., according to Diller.⁷⁵ The country rock is labradorite andesite, but a small plug of dacite porphyry lies a short distance north of the west end of the vein, as shown by the map (pl. 13). The vein matter from level 1 to the surface, which was completely weathered, was stoped, and according to the owners it was largely leached down to level 2. The high-grade ore shoot was 90 feet long and was stoped for about 140 feet for a width of 5 feet, of which 1½ to 2 feet was rich ore. In 1917 and 1918 test shipments of sorted ore containing abundant sulphides and some leached material from an intermediate level between levels 2 and 3 yielded the smelter returns shown below.

⁷⁴ Diller, J. S., op. cit. (20th Ann. Rept., pt. 3), p. 7.

⁷⁵ Idem, p. 28.

STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

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NORTHWESTERN OREGON

Oregon Metal Mines Handbook

By the Staff

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14-B — Northeastern Oregon — West Half
14-C — Southwestern Oregon
Vol. I — Coos, Curry, and Douglas Counties
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It is inferred that some may be as old as the Pliocene, but no definite proof has been evolved. Some flows in the High Cascades are definitely later than the latest extensive glaciation. During the Pleistocene the Western Cascades continued to be eroded and were somewhat modified by glaciation."

The Coast Range is made up of sandstones, shales, lavas, intrusives, and igneous fragmental rocks of Tertiary age. During the Tertiary, parts of Western Oregon were periodically covered by the ocean, and many thousands of feet of marine sandstones and shales were deposited.

Intrusions and outpourings of basaltic lavas occurred at least three times during the Tertiary, i.e., during the Eocene, middle Miocene, and late Pliocene or Pleistocene epochs. According to Baldwin (1947:29) gabbroic and dioritic sills of upper Oligocene age occur in the Coast Range in the Dallas and Valsetz areas. The oldest basalts frequently form the higher peaks in the center of the Coast Range. Miocene lavas cap the hills around Salem and south and west of Portland, and appear as flows and dikes in the western part of the Coast Range. The latest lavas form many of the small peaks around the Portland region. Subsequent uplifts caused the sedimentary beds and lavas to be folded along north-trending axes. The Tertiary beds under the Willamette Valley generally dip east beneath the lavas of the west slope of the Cascade Range; the sediments sometimes interfinger with the lavas.

Besides the great alluvial plains of the Willamette Valley and its larger tributaries, there are small areas of alluvium represented by the low-lying lands along the Columbia and limited areas of alluvium and sand dunes along some of the submerged coastal streams and on narrow coastal plains.

MINERAL DEPOSITS

Sulphide deposits of the Western Cascades

Mining properties and prospects in this bulletin are listed according to County. Those in the Cascade section of Clackamas, Marion, Linn, and Lane counties are grouped under districts designated as North Santiam, Quartzville, Blue River, Fall Creek, and Bohemia (see fig. 2 on opposite page). There is a general similarity of characteristics among these Cascade districts in history, mineralization, type of ore deposits, and operating problems. Total recorded production (1 to 1947) had a value of more than \$1,400,000, chiefly in gold, with the bulk of production from enriched oxidized zones.

All of the districts are dependent upon smelting facilities for economical ore treatment. The nearest smelters are at Tacoma, Washington, and Selby, California, and as shipment of concentrates requires a truck haul in addition to a railroad freight charge, transportation is a major handicap.

The following table, in part from Callaghan and Buddington (1938:24), shows the recorded production (1880-1947 from the principal Western Cascades deposits.

(From reports of the United States Mint, data of V. C. Heikes, and U.S. Bureau of Mines Minerals Yearbooks)

Districts	Gold oz.	Silver approximate oz.	Copper lbs.	Lead lbs.	Zinc lbs.	Approximate total value
North Santiam	454	1,412	41,172	40,700	110,063	\$ 25,257
Quartzville	8,550	2,920	---	---	---	181,255
Blue River	7,737	12,844	4,257	1,051	---	173,789
Bohemia	38,107	40,493	302,453	535,281	174,000	1,025,005
<u>Total</u>	54,848	57,669	347,882	577,032	284,063	\$1,405,306

there is a main vein from a few inches to 5 feet wide, striking about N. 43° W. and consisting of brecciated altered rock cemented by quartz. Some of the more massive quartz fragments contain disseminated sulphides, but generally the vein matter is thoroughly leached. Some small, more or less parallel quartz stringers and veins on both sides of the main vein have been cut by crosscuts.

Reference: Callaghan and Buddington, 1938:125-126.

Bohemia District

Location

The area (see fig. 6, map in pocket) is included chiefly in Tps. 22 and 23 S., Rs. 1 and 2 E., and is about 35 miles by road southeast of Cottage Grove. The principal productive area lies around Bohemia Mountain, occupying an area somewhat less than 9 square miles. Including outlying properties, the area is several times this figure. A logging railroad, connecting with the Southern Pacific at Cottage Grove, runs east to Disston, which is the nearest railroad connection for the district. Disston is 19 miles by road southeast of Cottage Grove.

The road from Cottage Grove to Bohemia forks at Sharps Creek, one branch going into the district by way of Sharps Creek and the other by way of Frank Brice and Champion creeks. There are numerous trails leading to outlying properties.

Topography

At the southern limits of the Willamette Valley, the divide separating the drainage of the Willamette and Umpqua rivers is known as the Calapooya Mountains, which form an east-west connecting link between the Cascade and Coast ranges. The Bohemia District lies on and around the eastern part of this divide in an area characterized generally by high, rugged summits and steep, heavily timbered slopes. The principal peaks have altitudes as follows: Bohemia Mountain, 5,987 feet; Fairview, 5,933 feet; Grouse, 5,570 feet; Grizzly, 5,450 feet; North Fairview, 5,550 feet; and Elephant, 5,522 feet. Many of the mines are at altitudes of 4,000-5,000 feet. Callaghan and Buddington (1938:39-40) state:

"Glaciation has modified the upper parts of the valleys, particularly on northern and eastern slopes, and glacial debris extends down the valley of Champion Creek possibly as far as the mouth of Golden Curry Creek, or to an altitude of 3,100 feet. Glacial cirques, some of them with lakes and muskegs, are best represented by Crystal, Golden Curry, Champion, Horseheaven, and Musick Basins. Some of the veins, particularly the Musick, have been eroded by glaciers. Possibly others have been covered by glacial debris, as in the vicinity of the old Champion mill."

History

The Bohemia district surpasses all the other mining districts of the Oregon Cascades^x in area, number of producing properties, amount of development work, and total production. Gold was first discovered in this region in 1858, and the first stamp mill was built in 1875. The Musick vein, the first of importance to be discovered, was located in 1891, and a 5-stamp mill was built there. The Champion put in a 10-stamp mill in 1895 and the Noonday a 20-stamp mill in 1896 (Diller, 1900:7).

Between 1902 and 1912 the Champion, Noonday, and Musick mines were consolidated under the West Coast Mines Company, which operated a 30-stamp mill. The Noonday was productive between 1896 and 1908. Other producers at various times have been the Vesuvius (active previous to 1921) and Evening Star. Between 1932 and 1938 the Mahala mines, the Bartels Mining Company, and the Minerals Exploration Company produced ore valued at more than \$400,000.

The main mines were again consolidated in 1939 under the H. & H. mines, who completed construction of a mill and power plant at the Champion mine in 1942, but suspended operations in August due to high cost of material and shortage of labor.

Since 1945 some ore has been produced from the Helena mine under the management of Kenneth Watkins, and from the Champion mine by Fred J. and William Bartels. The mill at the Champion mine was reconditioned in 1946, and some tailings from the Musick and ore from the Helena and Champion mines were concentrated by flotation in 1948 and 1949.

Geology and ore deposits

Speaking generally, rocks in the Bohemia district and their relationships are the same as in the other Cascade districts. The geology and ore deposits are described in detail by Callaghan and Buddington (1938:40-49). Bedded northeast-dipping volcanic flows of tuffs, breccias, rhyolite, and andesites make up the bulk of the rocks. There are dikes of andesite and several scattered intrusions, in the form of dikes, plugs, and a stock, of dioritic rock to which the ore deposits are believed to be genetically related. These intrusives have altered surrounding volcanics forming contact metamorphic zones.

The veins have a dominant trend to the north and northwest. About half of them strike N. 50°-70° W., about a quarter N. 70°-90° W., and the remainder N. 30°-50° W. Dips are mainly 60°-80° S. Most of the veins with a northwesterly strike are in the southern half of the district; those with a westerly strike are in the northern part. They are younger than any of the rocks in the district, and consist, in most places, of brecciated, altered, and partly replaced country rock cemented by or containing fissure fillings of drusy or comb quartz that locally contain sulphides.

Gold, largely from the oxidized portions of the sulphide veins, has been the principal commercial metal mined. The dominant sulphide is sphalerite, which is associated with galena, chalcopyrite, and pyrite in varying amounts, and in some places with a small amount of tetrahedrite. Primary specularite is associated with the quartz in several of the veins. Galena is dominant in the Musick vein, chalcopyrite in the Oregon-Colorado, and stibnite in the Tall Timber and El Capitan veins. Although a few high-grade pockets have been found, the gold content of the unweathered sulphide ores is generally low. There is a rough areal zonal distribution of mineral deposits with respect to the intrusive rocks. The area of most intensive igneous intrusion contains base-metal quartz veins with variable amounts of gold and in places specularite and dolomite; in areas where there are fewer intrusive bodies the veins carry less sulphide, more carbonate, and occasionally stibnite. The properties are classified by Callaghan and Buddington (1938:47-48) as follows:

Base-metal veins with varying amounts of gold:

Champion	Crystal	Veins with specularite:
Helena	Grizzly	Gold Cross (in War Eagle)
Musick	Shotgun	Orofino
Noonday	Utopian	Alpharetta
Vesuvius	Vindicator	Sultana
	War Eagle	Cape Horn

Veins of quartz and clay minerals (not productive):

North Fairview
Syndicate

Pyrite and cherty quartz veins:

Sultana (in part)
Cape Horn (in part)
Orofino (in part)
Golden Slipper
Northern vein east of Helena No. 2 camp.

Chalcopyrite-quartz veins:

Oregon-Colorado

Gold-quartz and gold-calcite-quartz veins (western part of district):

Star

West part of Cripple Creek group

President

Stibnite-pyrite-quartz veins:

Tall Timber

President

Specularite and magnetite veinlets and disseminated specularite:

Fractures in hornfels adjacent to many of the intrusive bodies.

Disseminated pyrite:

In contact zones around the small intrusive bodies, and in the outer part of the large areas of contact-metamorphic rock.

In the early days mining was carried on mainly in oxidized parts of oreshoots. When the sulphides appeared in the ore and values could not be recovered by amalgamation, the properties shut down. In recent years small flotation plants have been built, but activity has been intermittent. The 100-ton flotation mill at the Champion mine is available for custom milling of ore from other properties in the district and may aid in increasing the recovery of base metals. Callaghan and Buddington (1938:47) state that:

"The value per ton in terms of recovered metals for outputs of 100 tons or more for the various mines since 1902 has ranged from \$1.20 to \$16 (with gold figured at \$20.67 an ounce). . . . The average value per ton for the largest operation, that of the combined Musick and Champion mines, was \$6.90 for 14 years. Annual averages for years in which more than 1,000 tons was milled range from slightly less than \$5 to slightly more than \$9 a ton (\$20.67 an ounce for gold)."

While these comments are pertinent to the matter of economics of operation under discussion, it would not be fair to place a gross average value on the ore or to judge present-day possibilities from these figures. Undoubtedly much of the milling done was inefficient and poor recoveries were made. On the other hand a much greater proportion of enriched ore was treated than could be mined today. Present-day operations would be mainly from sulphide ores which have a lower gold content. As against this, there are the two factors of a higher dollar value for gold and the efficient flotation process for separating complex sulphide ore.

Taber (1949:12) made the following summary pertaining to the grade of the ore in the Bohemia district:

"The metal content of the sulfide ores differs considerably from place to place. The gold content ranges from a trace to about 1 ounce. High-grade pockets have been found that contained as much as 10 ounces of gold per ton. The Helena mine has produced several such pockets. The silver averages about 2 ounces per ton, the lead 3 percent, the zinc 5 percent, and the copper about 1 percent. In many of the veins, zinc is the predominant sulfide metal. In a few, notably the Musick vein, lead is more abundant than zinc."

MINERAL KING PROSPECT

Bohemia District

Location: SE $\frac{1}{4}$ sec. 20, T. 23 S., R. 2 E., on Horse Heaven Creek. Workings are also reported on Windy Creek half a mile south either in sec. 28 or 29.

Development: A tunnel over 200 feet long runs S. 10°-60° E. into the steep hillside from a point on the east bank about 100 feet above the creek and 300 feet due south of the old cabin and camp. The tunnel is caved 125 feet in and contains water beyond this point, but extends S. 30° E. for at least 150 feet farther.

The Calapooya Mining and Tunnel Company was reported by Stafford (1904) to have development amounting to 100 feet of open cuts and 600 feet of tunnels on Windy Creek half a mile farther south.

Geology: The country rock is a massive, fine-grained dark gray andesite, cut by narrow, nearly vertical veins striking N. 30°-60° W. The veins are from a few inches to 3 feet in width and consist of altered rock and clay gouge with irregular areas containing calcite and sparsely disseminated pyrite.

Report by: J.E.A., 1945.

Reference: Stafford, 1904

MUSICK MINE (Gold, silver, copper, lead, zinc)

Bohemia District

Owner: Tar Baby Mining Company, Salt Lake City, Utah, but leased by Helena Mines, Inc.

Location: Principal workings at the head of City Creek in Bohemia Saddle on north slope of Bohemia Mountain in N $\frac{1}{2}$ sec. 14, T. 23 S., R. 1 E., about 1 mile southwest of Champion mine.

Area: 14 unpatented claims according to Taber (1949:28).

History and production: The Musick vein, discovered by James C. Musick in 1891, is one of the earliest found in the district. He organized the Bohemia Gold Mining and Milling Company, built a 5-stamp mill, and operated the property until 1901. In 1902 the Musick, Helena, and Champion mines were acquired by the Oregon Securities Corporation. Ore was hauled from the Musick mine to the Champion mine by electric tram and by cable-bucket tram from the portal of the Champion mine to the mill in Champion Creek gulch.

West Coast Mines Company bought the Oregon Securities Corporation holdings in 1908. This company sold the Musick mine to L. M. Capps of Idaho in 1921. The Minerals Exploration Company leased the mine in 1935, built a 22-ton gravity concentrator mill, and produced \$101,000 worth of concentrates in 1936 and 1937. About 1939, Higgins and Hinsdale Mines Company obtained a lease on the property but operations were stopped because of World War II. Kenneth O. Watkins bought the H. and H. Mines Company lease in 1944, and sold his contract in 1945 to the Tar Baby Mining Company of Salt Lake City, Utah. This company acquired the property from the L. M. Capps estate in 1946. In 1948 the mine was leased to the Helena Mines, Inc., who subleased the east end of the mine to Wyatt, Nordstrom, and Smith. This group did development work, using the main level of the Musick mine to reach their adjoining claims. In 1949 some Musick dump ore was hauled to the Champion mill for treatment.

Development and equipment: The Musick vein has been developed by more than 6,000 feet of drifts and crosscuts plus numerous stopes, raises, and winzes. Three main levels about 100 feet apart explore the vein for nearly 1,800 feet. The California vein, which is north of the Musick vein and merges with it to the west, has been explored on the surface by pits and outcrops for about 1,500 feet. The Mystery and Alpharetta veins have been prospected by shallow pits, trenches, and drifts. A short adit, known as the Cline, has been driven on a vein 600 feet east of the Alpharetta vein.

The bunkhouse at the camp was partially destroyed by snow in 1948. The mill house was also in poor condition. A steel snow shed partly covered the haulage track from the main tunnel.

Geology: In general, the geology is the same as for the Champion mine. The Musick vein differs from other veins in the district by having sharp bends in its course. The strike varies from N. 42° W. to west and where best exposed the dip varies from 65° S. to vertical.

The country rock is light-colored rhyolite except for a few exposures of andesite and tuff. The ore has the usual sulphides but contains a higher-than-usual proportion of galen. Several splits in the vein enclose lenses of country rock. Shoots as much as 375 feet long and 3 to 5 feet wide have been stoped. Samples vary in gold content. Weathered ore assay as high as 1.4 ounces of gold and about 2 ounces of silver to the ton (Callaghan and Buddington, 1938:58). Taber (1949:30) reported that a sample taken by him in 1946 from broken rock in the stopes contained 0.38 ounce of gold, 1.7 ounces of silver, 1.2 percent copper, 5.6 percent lead, and 5.7 percent zinc.

References: Callaghan and Buddington, 1938:57-60
Parks and Swartley, 1916:234-235
Stafford, 1904
Taber, 1949:28-30

NOONDAY MINE (Gold, silver, copper, lead, zinc)

Bohemia District

Owners: John C. Higgins of the H. and H. Mines Company, Portland, Oregon.

Location: W $\frac{1}{2}$ sec. 18, T. 23 S., R. 2 E., on the east slope of Grouse Mountain, and south rim of Horse Heaven Basin.

Area: 6 claims: 5 patented (Henry, Annie, Maggie, Fraction, Emma) and Mandy, unpatented

History and production: The property was opened in 1891 or 1892 and operated intermittently a 20-stamp mill until 1908. A new mill in Horse Heaven Basin and an aerial tram were constructed, but the ore was not free milling and the mine shut down. Small shipments of sorted ore were made in 1917 and 1918. Recorded production was nearly \$96,000 up to 1919; this may have included some Helena production. In 1934 the property was operated by the Grouse Mountain Mining Company, and produced \$50,000. In 1936 and 1937 K. O. Watkins mined a small amount of ore. The U.S. Bureau of Mines Minerals Yearbook reported a production of 380 tons of ore in 1937. In 1939 the property was purchased by the H. and H. Mines Company, who did some development work. In 1945 the Silver Shield Mining and Milling Company of Salt Lake City, Utah, obtained a lease and option to purchase the property. It has since that time reverted to John C. Higgins of H. and H. Mines Company.

Development: The mine has been developed on 3 principal levels and various sublevels. Diller (1900:28) reported 2,000 feet of workings; Stafford (1904) reported 4,300 feet of tunnels and 500 feet of raises. The workings were largely inaccessible in 1931 at the time of the U.S. Geological Survey reconnaissance.

In 1945 most of the workings on levels No. 2 and No. 3 were open. Level No. 2 is reached by a crosscut running southwest 130 feet to drifts running N. 55°-60° W. on the Annie vein. The No. 3 level, 168 feet below level No. 2, is reached by a crosscut running S. 27° W. for 430 feet to the Annie vein. There are three sublevels between the No. 2 and No. 3 levels at 39 feet, 57 feet, and 110 feet respectively below the No. 2 level. The No. 3 level intersects the Henry vein 80 feet from the portal. The drift on the Annie vein runs north 600 feet, mostly paralleling the vein a little to the north, with several short crosscuts to it. About 350 feet west of the main crosscut an exploratory crosscut has been driven 400 feet S. 25°-35° W. to intersect the Maggie vein.

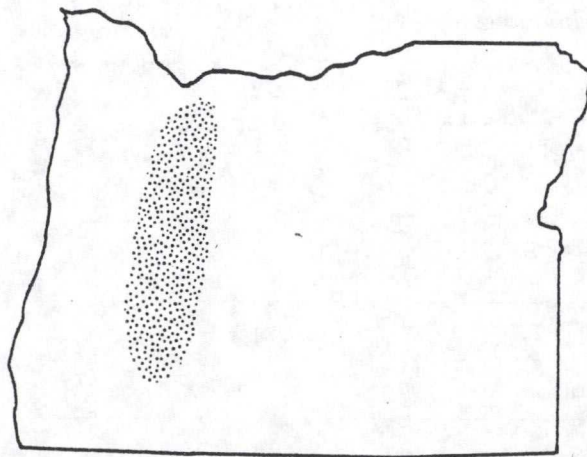
Geology: The mineralization is similar to other base-metal veins in the Bohemia District. Three veins, the Henry, Maggie, and Annie, are known. The mine is located on the Annie vein. Country rock is labradorite andesite, with a small plug of dacite just north of the west end of the Annie vein.

THE WESTERN CASCADES

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**part three. deposits in western oregon
the western cascades**



BOHEMIA DISTRICT

Location

The Bohemia district is in Townships 22 and 23 S., Ranges 1 and 2 E., in Lane County (plate 3). It is the largest and most productive mining area in the Western Cascades. The district lies about 35 miles southeast of Cottage Grove and is reached by way of the Row River road and forest roads which follow Sharps Creek and Brice Creek, making a loop through the area.

The mineralized area is roughly circular and about 5 miles in diameter. Elevations range from just under 2000 feet on Champion Creek near the north edge of the map area to 5933 feet on Fairview Peak, the highest point in the district. The area is drained by tributaries of Brice, Sharps, and Steamboat Creeks.

Geology and Mineralization

Oligocene and lower Miocene volcanic rocks having a maximum thickness of 6500 feet underlie the Bohemia area. These rocks are assigned to the Little Butte Volcanic Series by Peck and others (1964). Callaghan and Buddington (1938, p. 40) describe the geology as follows:

"...These rocks comprise tuffs, volcanic breccias, and andesite lavas in about equal amounts, with minor lenses of coarse volcanic breccia and agglomerate and flows of rhyolite intercalated in the tuffs....These rocks commonly dip at low angles to the northeast and east, although locally the dips vary, and some east-southeast dips were observed. Several dikes of andesite varying widely in strike traverse the bedded volcanic rocks and are presumed to be closely related to them. A considerable number of small plugs, dikes, and a stock of dioritic intrusive rocks occur in a belt extending northward through the central part of the area. They are included in an area of hornfels $3\frac{1}{2}$ miles long and half to three-quarters of a mile wide."

Lutton (1962) divides the volcanic rocks of the area into lower, middle, and upper units. His lower unit is composed of about 1000 feet of massive pyroclastic rocks overlain by about 300 feet of well-bedded tuffaceous shale and sandstone. His intermediate unit is composed of andesite to rhyolite domes and flows with intercalated pyroclastics which crop out in a wide, northwest-trending belt and range in thickness from 1200 to 1700 feet. The upper unit is mainly andesite and basalt flows, comprising 2000 feet of lavas with interlayered lapilli tuff at the base, overlain by 1000 feet of basic lavas.

Lutton maps three age groups of intrusive rocks. The oldest are porphyritic dacite dikes; the intermediate are basic dikes and sills; and the youngest are granitoid intrusives. The porphyritic dacite dikes strike mainly west to northwest, generally parallel to the mineralized quartz veins. Lutton believes them to be contemporaneous with his intermediate unit of andesite and rhyolite domes and probably of late Oligocene age. He suggests that the granitoid intrusives are of late Oligocene or Miocene age, and that the basic dikes and sills are of various ages, in part contemporaneous with the basic flows of his upper unit.

The veins in the area strike mainly northwest and west and the majority dip steeply southwest and south. Callaghan and Buddington (1938, p. 44) state that most of those with a northwesterly strike are in the southern half of the area, whereas those with a westerly strike are in the northern part. The general features of the mineral deposits in the district are described by Callaghan and Buddington as follows:

"Though the Bohemia district covers a roughly circular area of about 60 square miles, the main mineralized belt occupies an area $5\frac{1}{2}$ miles long and $1\frac{1}{2}$ miles wide trending N. 60° W. It includes the Mayflower, Riverside, and Oregon-Colorado mines at the southeast and the Utopian, Sweepstakes and Musick at the northwest. Gold has been the principal ore mined and has been obtained largely from the oxidized parts of sulfide veins. The veins are

younger than any of the other rocks in the district, including the intrusive bodies. The vein matter in most places consists of brecciated, altered, and partly replaced country rock cemented by or containing fissure fillings of drusy or comb quartz that locally contains sulfides. In some veins there are bodies of cherty quartz with pyrite crusts along intersecting short fractures. The dominant sulfide, sphalerite, is associated with galena, chalcopyrite, and pyrite in varying amounts, and in some places with a little tetrahedrite. Galena is the dominant sulfide in the Musick vein, chalcopyrite in the Oregon-Colorado, and stibnite in the Tall Timber. Primary specularite is associated with quartz in several of the veins. The gold content of the unweathered sulfide ores is low in most places, though a few high-grade pockets have been found. There is a rough areal zonal distribution of mineral deposits in relation to intrusive rocks. Base-metal quartz shoots with variable amounts of gold and in places with specularite and dolomite are grouped in the area of most intensive igneous intrusion; and veins with generally less sulfide, more carbonate (commonly calcite), and in places stibnite occur in an area to the south, where there are fewer intrusive bodies."

Taber (1949, p. 12) described grade of the ore as follows:

"The metal content of the sulfide ores differs considerably from place to place. The gold content ranges from a trace to about 1 ounce. High-grade pockets have been found that contained as much as 10 ounces of gold per ton. The Helena mine has produced several such pockets. The silver averages about 2 ounces per ton, the lead 3 percent, the zinc 5 percent, and the copper about 1 percent. In many of the veins, zinc is the predominant sulfide metal. In a few, notably the Musick vein, lead is more abundant than zinc."

Lutton (1962) discusses the factors favorable to ore deposition. Among them he lists: 1) proximity to the center of mineralization, which he believes is probably a cupola; 2) open channels formed in the steep portions of irregular, dipping veins as the result of normal faulting; 3) concentrations of subsidiary veinlets so numerous that they form an ore body; and 4) vein intersections which give rise to ore bodies.

The distribution of veins and areas of rock alteration (shown on plate 3) and the areal mineral temperature zoning described by Callaghan and Buddington (1938, p. 48-49) may be evidence for a hidden intrusive body, or cupola, at depth beneath the central portion of the mineralized zone, as suggested by Lutton (1962, p. 137).

History and Production

Diller (1900, p. 7) reports that the Bohemia mining region was discovered by Dr. W. W. Oglesby of Junction City and Frank Brass in 1858. The name "Bohemia" originated from the nickname of James Johnson, who was popularly known as Bohemia Johnson. Johnson and George Ramsey discovered gold near the head of City Creek in 1863 and this brought in many prospectors.

The first five-stamp mill was built in 1872 on the Knott claim, now part of the Champion property. The Musick mine, the first vein found in the area, was located in 1891. The Noonday was opened in 1892. A 10-stamp mill was installed at the Champion mine in 1895 and a 20-stamp mill at the Noonday in 1896. By 1902 not less than 2000 claims had been filed in the district, although some were undoubtedly duplicate recordings. Between 1902 and 1912 West Coast Mines Co. consolidated the Champion, Helena, and Musick mines and erected a 30-stamp mill at the Champion. The Noonday was a producer between 1896 and 1908. The Vesuvius and Evening Star mines were also producers during the early 1900's.

Between 1932 and 1938 the Mahala Mines Co., the Bartels Mining Co., and the Minerals Exploration Co. produced ore with a total value of more than \$400,000.

Between 1939 and 1942 Higgins and Hinsdale (H. & H. Mines, Inc.) completed some development work and erected a flotation mill and power plant at the Champion mine. These operations were suspended in 1942 before major production was attained; however, considerable development ore was milled (Harold Barton, oral communication, 1967). In 1944, F. J. Bartels acquired the mill and property from H. & H.

Mines. Bartels produced a small amount of gold from the Champion and Evening Star mines between 1945 and 1949 and milled ore from the Helena mine, which was operated by K. O. Watkins. In 1950 Watkins obtained the Champion lease and operated the Champion mill, producing about \$35,000*.

In 1961 and 1962 the Office of Minerals Exploration contracted to help finance a long drift to expose the Musick vein 335 feet below the old No. 6 level. Work was done by the Emerald Empire Mining Co.

In 1964 a diamond-drilling program was announced by Federal Resources Corp. of Salt Lake City to explore the Champion, Evening Star, Musick, and other nearby properties. The program was modified to include drilling on extensions of the Helena vein and a production drift on the California-Defiance veins of the Musick; this is known as the 1000 level and work was completed at 1196 feet on May 5, 1965*.

The main production from the Bohemia district has come from the Champion, Helena, and Musick mines. A fair amount of output has also come from the Noonday, Vesuvius, and Star mines. Total production for the district is estimated to be about one million dollars. Between 1880 and 1900, according to U.S. Mint reports, Lane County (mainly the Bohemia district) produced 14,590.69 ounces of gold and 1,418.79 ounces of silver. Between 1901 and 1930, according to U.S. Bureau of Mines records, the district produced from 42,548 tons of crude ore a total of 13,694.59 ounces of gold, 8,148 ounces of silver, 14,831 pounds of copper, and 120,816 pounds of lead. Zinc was present but was considered a liability in the concentrates.

Principal Mines

The principal mines in the district are the Champion, Helena, and Musick. Since the district contains such a large number of similar veins, no attempt is made here to describe all of the prospects. Those with the more complete information and extensive development are included in the alphabetical list.

Champion mine: The Champion mine property consisted of one patented and 22 unpatented claims as reported by Taber (1949). It is located near Champion Saddle on the divide of Champion and City Creeks in the N $\frac{1}{2}$ sec. 13, T. 23 S., R. 1 E. The principal development is on the west- to northwest-striking Champion vein over a total distance of about 2600 feet along the strike and to an average depth of about 800 feet below the outcrops. The vein was originally developed in two separate properties. The Evening Star workings entered from the City Creek side and developed the southeastern portion of the vein. The Champion workings entered from the north side of the ridge. The two workings were eventually connected on the 600-foot level. Total development includes more than 15,000 feet of drifts and crosscuts and about 3000 feet of raises, on nine levels. Three of the main levels (600, 900, and 1200-foot) have adits.

The Champion vein varies in thickness from 1 to 8 feet and has averaged about 3 feet. Taber (1949, p. 24) describes the ore remaining in the mine as mainly sulfides similar to that of other mines in the district. The gold content is generally just under 0.5 ounce per ton. A few small, partly oxidized ore shoots remaining in the mine contain as much as 2 ounces of gold per ton, and a few shoots of oxidized ore of higher grade have been mined. Watkins (1946) states that an average of 1548 samples taken by H. & H. Mines Co. from all parts of the mine (weighted against width of sample) was as follows:

<u>Oz. gold</u>	<u>Oz. silver</u>	<u>Percent lead</u>	<u>Percent zinc</u>	<u>Percent copper</u>
0.555	4.21	1.72	2.15	1.71

Taber (1949, p. 24) describes the wall rocks as andesite, rhyolite tuff, and granodiorite porphyry and the vein minerals as sphalerite, pyrite, chalcopryrite, galena, hematite, and cherty to coarsely crystalline quartz. Silicification and sericitization of the wall rocks are common.

History of mining operations at the Champion is summarized by the Department (Bulletin 14-D, 1951, p. 58) as follows:

* Information supplied by Harold Barton, oral communication, 1967.

"The Champion vein was discovered in 1892, and in 1895 a 10-stamp mill was built on that property. In 1902 the Champion, Helena, and Musick mines were consolidated under the West Coast Mines Co. A 30-stamp mill was built at the Champion mine and it ran until 1908, partly on ore from the other properties. Only a small amount of development work was done between 1912 and 1916, and no mining was carried on between that time and 1930. During the period 1932 to 1938 approximately \$100,000 was produced from the Champion by several operators, including the Mahala Mines and the Bartels Mining companies. In 1939 the property was taken over by Higgins and Hinsdale (H. & H. Mines) who built a mill and power plant and did several thousand feet of development work including most of the 1200-foot level. Operations were suspended in August 1942, however, due to high cost of materials and shortage of labor, before production had been attained. The property and mill were turned over to F. J. Bartels in 1944. From 1945 through 1949 a few cars of concentrates were shipped as well as some cars of run-of-mine gold ore." A recent photograph of the mill is shown in figure 60.

Helena mine: In 1949 the Helena mine property consisted of three patented and seven unpatented claims. Workings are on a northwest-striking vein in secs. 7 and 18, T. 23 S., R. 2 E. The vein extends across the SW $\frac{1}{4}$ sec. 7 and a short way into the SE $\frac{1}{4}$ sec. 12, T. 23 S., R. 1 E. The Helena No. 2 and other workings on Helena claims in the SE $\frac{1}{4}$ sec. 12 are on what appears to be a branching vein. The principal development is on the southeastern end of the vein, in the north edge of sec. 18, where it penetrates a large east-trending granodiorite porphyry dike.

The vein was discovered in 1896. Two ore-shoots were mined during the mining boom that lasted until 1907. Production to 1931 is estimated by Callaghan and Buddington (1938, p. 55) at \$150,000. The mine has a history of several owners and operators. A 35-ton flotation mill was built in 1935. Additional production to 1949 was approximately \$100,000, bringing the total to about \$250,000. Small production in 1950 and 1962 would not increase this significantly. The 1964 core-drilling program disclosed characteristic sulfide mineralization both east and west of the productive zone (Harold Barton, oral communication, 1967).

Taber (1949, p. 28) describes the workings as follows:

"The mine has been developed by three principal levels and three short adit drifts. Altogether, there are about 2000 feet of drifts and crosscuts and about 500 feet of raises. All of the principal levels are connected by raises, so that the lowest (No. 7 level) may be used as a general haulage level for the mine. Except for about 100 feet of the No. 6 level, which has been stoped out, all of the drifts are open and in good condition."

The Helena vein is a strong fissure which strikes about N. 57° W. and dips 65° to 70° NE. Taber (1949, p. 27) states it is the only strong northwest-striking vein that has a northeasterly dip. It has been explored over a distance of about 3000 feet. Three ore shoots mined were discovered at the surface and mined down to about 200 feet of depth. Their length was 50 to 200 feet and thickness 3 to 8 feet, averaging 4 feet. Callaghan and Buddington (1938, p. 55) describe the sulfide ore as consisting "... chiefly of sphalerite with some pyrite, chalcopyrite, galena and a little tetrahedrite with quartz, included rock fragments, kaolin, and barite. Several stages of vein filling are shown." Grade of the ore is reported to have been quite high. Four grab samples taken by Taber from the new ore shoot at the face of No. 7 level averaged 3.15 oz./ton gold, 2.8 oz./ton silver, 4.8 percent lead, 5.8 percent zinc, and 1.2 percent copper. The paradox of relatively small amount of development with a good quality of ore is explained by Taber (1949, p. 25) as probably due to the unusually shallow depth of oxidation in the ore shoots, which limited the quantity of easy-milling ore.

Musick mine: The Musick mine is situated about 1 mile west of the Champion mine in N $\frac{1}{2}$ sec. 14, T. 23 S., R. 1 E. The Lower Musick is on Sharps Creek in NE $\frac{1}{4}$ sec. 15. The Musick Group had 14 unpatented claims situated in sec. 14 in 1949. History of the Musick is described as follows (Department Bulletin 14-D, 1951, p. 69):

"The Music vein, discovered by James C. Musick in 1891, is one of the earliest found

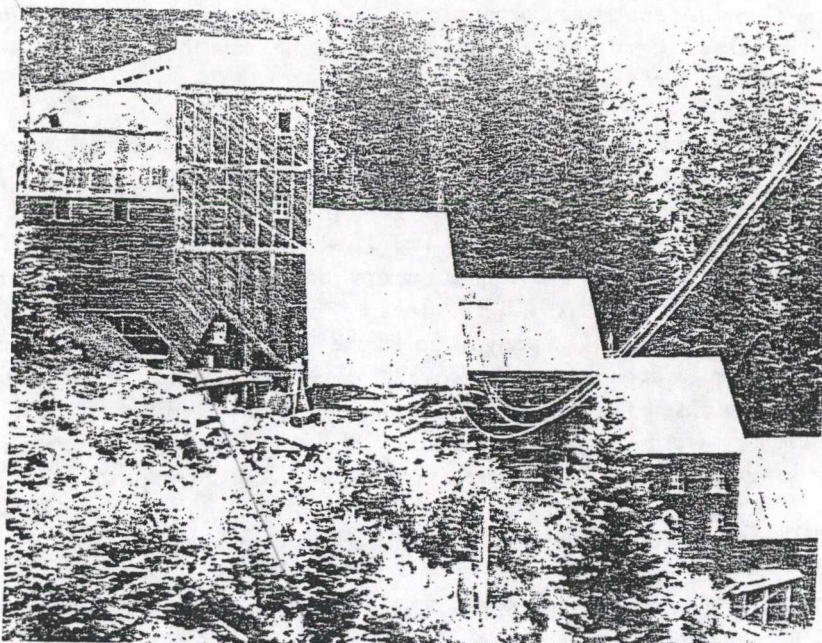


Figure 60. The Champion mill, a 100-ton selective flotation plant, processed ore from the Champion and Musick mines. Photograph taken in 1964 by Fred E. Miller.

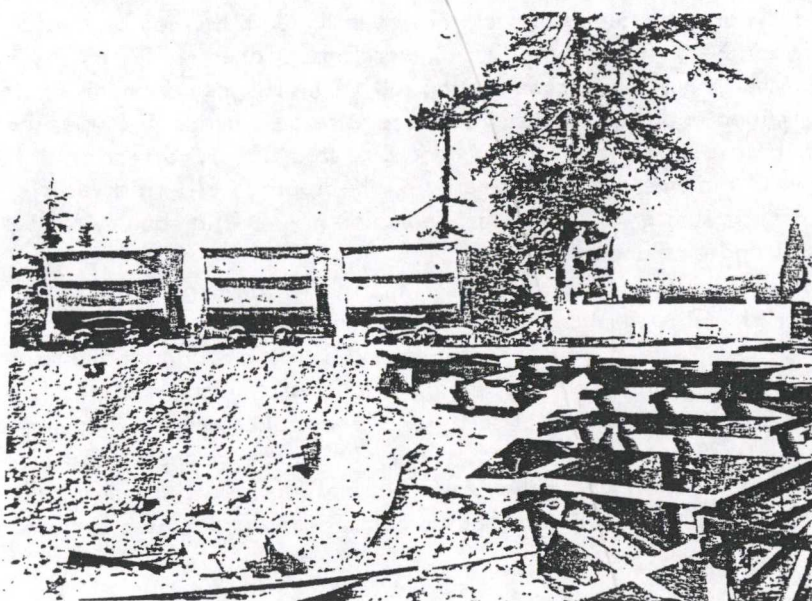


Figure 61. A scene near portal of the new exploration tunnel at the Musick mine showing air-driven locomotive and ore cars. Photograph taken in 1964 by Fred E. Miller.

in the district. He organized the Bohemia Gold Mining and Milling Co., built a 5-stamp mill and operated the property until 1901. In 1902 the Musick, Helena, and Champion mines were acquired by the Oregon Securities Corporation. Ore was hauled from the Musick mine to the Champion mine by electric tram and by cable bucket tram from the portal of the Champion mine to the mill in Champion Creek gulch.

"West Coast Mines Company bought the Oregon Securities Corporation holdings in 1908. This company sold the Musick mine to L. M. Capps of Idaho in 1921. The Minerals Exploration Company leased the mine in 1935, built a 22-ton gravity concentrator mill, and produced \$101,000 worth of concentrates in 1936 and 1937. About 1939, Higgins and Hinsdale Mines Company obtained a lease on the property but operations were stopped because of World War II. Kenneth O. Watkins bought the H. and H. Mines Company lease in 1944, and sold his contract in 1945 to the Tar Baby Mining Company of Salt Lake City, Utah. This company acquired the property from the L. M. Capps estate in 1946. In 1948 the mine was leased to the Helena Mines, Inc., who subleased the east end of the mine to Wyatt, Nordstrom, and Smith. This group did development work, using the main level of the Musick mine to reach their adjoining claims. In 1949 some Musick dump ore was hauled to the Champion mill for treatment."

In 1949 and 1950 ore from the Wyatt stope was milled at the Champion.

Beginning in 1961 the Emerald Empire Mining Co., with financial assistance from the O. M. E., drove a 1662-foot drift tunnel 335 feet below the No. 6 level (figure 61). The new lower adit enters from the Sharps Creek side at about 4660 elevation. Work was completed in November 1962. Results of the new exploratory work were disappointing, in that very little good ore was found in widths of greater than 30 inches in the new drift. The Musick mine has more than 7660 feet of drifts and crosscuts plus numerous stopes, raises, and winzes that explore the vein for approximately 5000 feet along the strike and to a depth of about 800 feet. The California vein, which lies north of the Musick and merges with it, has been explored by surface pits and outcrops for about 1500 feet. The vein apparently continues east and is called the War Eagle, thus covering a distance of greater than a mile (Harold Barton, oral communication, 1967). Some additional development work has been done on the nearby Mystery, Alpharetta, and Ophir veins which lie southeast of the main Musick workings. Taber (1949, p. 29) calculated that total production from the Musick may have been about \$280,000. His measurements of stopes indicated at least 40,000 tons were mined and that this total would require an average of \$7 per ton recovery.

The Musick vein strikes from N. 45° W. to W. and dips from 65° S. to vertical. It contains splits in the fissure and merges with the west-striking, steeply south-dipping California vein.

Geology of the Musick is similar to that at the Champion mine. The country rock is mainly rhyolite with a few exposures of andesite and tuff.

The Musick has the usual mixture of sulfides but with slightly lower gold content and higher lead than other veins in the district. The gangue is siliceous and fragments of wall rock occur mixed in the vein. Shoots in the Musick vein as much as 375 feet long and 3 to 5 feet thick have been stoped. Assays (of weathered ore) reported by Callaghan and Buddington (1938, p. 58) are as high as 1.4 ounces of gold and 2 ounces of silver per ton. A sample of partly oxidized broken ore from the stopes reported by Taber (1949, p. 30) assayed 0.38 oz. gold, 1.7 oz. silver, 1.2 percent copper, 5.6 percent lead, and 5.7 percent zinc. West of the location where the California and Musick veins merge, the resulting vein is wider (8 to 12 feet) than the main Musick vein, but it contains less ore mineralization.

Lode Mines of the Bohemia District

Champion (Evening Star) mine

Bohemia District, 1

- Location: Lane County, N $\frac{1}{2}$ sec. 13, T. 23 S., R. 1 E. between 4400 and 5500 feet elevation.
- Development: More than 15,000 feet of drifts and crosscuts and about 3000 feet of raises on 9 levels.
- Geology: Vein is a fissure with brecciated country rocks cemented by vuggy quartz containing sphalerite, pyrite, chalcopyrite, galena, and hematite that is oxidized near the surface. Country rocks are rhyolite, tuff, hornfels, and granodiorite. Average vein width is about 3 feet. Strike of the Champion vein is west to about N. 45° W. and dips average about 70° SW.
- Production: Mine was discovered in 1892. A 10-stamp mill was built in 1895; a 30-stamp was built in 1902 and operated until 1908. Approximately \$100,000 was produced during the 1932 to 1938 period. Operations continued under new ownership until 1942, during which time a new selective flotation mill was installed. A few cars of concentrates and mine-run ore were shipped from 1945 to 1952. Partial production statistics reported by Taber, 1949, p. 23, are: 24,297 tons crude ore; 5471 ounces gold; 16,434 ounces silver; 189,583 pounds copper; 63,196 pounds lead; and 5550 pounds zinc.
- References: Diller, 1900:26-27; MacDonald, 1909:83-84; Parks and Swartley, 1916:234; Smith and Ruff, 1938:42-44; Taber, 1949:22-25; Department Bull. 14-D, 1951:57-59.

Crystal (Lizzie Bullock) mine

Bohemia District, 2

- Location: Lane County, N $\frac{1}{2}$ sec. 11, T. 23 S., R. 1 E., about 5000 feet elevation.
- Development: Lowest drift, 4580-foot level, is 400 feet long; upper drift, 4690-foot level, is 100 feet long. Other short drifts are present but workings are mostly inaccessible.
- Geology: Country rocks are andesitic lavas, tuffs, and breccias. Crystal vein is quartz-cemented fault breccia with pyrite, sphalerite, chalcopyrite, and galena. Vein which strikes N. 65° W. dips steeply SW. and has been explored for 3300 feet. Reported average of 108 samples in lower workings was .03 ounce per ton gold, 2.0 ounce per ton silver, 1.1 percent copper, 2.0 percent lead, and 2.9 percent zinc. Thickness of vein was reported by Diller to be 6 feet and 7 feet.
- Production: A two-stamp, water-driven mill was operated in the 1890's, during which time there was a small production, but no accurate records are reported.
- References: Diller, 1900:25; Callaghan and Buddington, 1938:66-67; Taber, 1949:40-41; Department Bulletin 14-D, 1951:60-61.

El Capitan (President Group)

Bohemia District, 3

- Location: Lane County, center E $\frac{1}{2}$, sec. 23, T. 23 S., R. 1 E., about 4000 feet elevation.
- Development: Two adits total 380 feet; upper tunnel, caved in 1941; and various cuts.

Geology: Country rocks are andesite flows and tuff breccias dipping eastward that are intruded by a diorite plug to the south. Sinuous vein strikes N. 60° to 70° W., dips 80° S. to vertical, and is 15 to 30 inches thick. Vein contains vuggy quartz breccia, calcite crystals in cavities. Sulfides are pyrite, stibnite, chalcopyrite, galena, and sphalerite. A portion of the vein contains at least 25 percent stibnite. The vein has been explored for more than 1000 feet.

Production: Located about 1898. Production has been small. A two-stamp mill was reported on the property in 1930. Lane Minerals shipped a half carload of ore in 1959.

References: Parks and Swartley, 1916:55; Callaghan and Buddington, 1938:67; Taber, 1949:50; Department Bulletin 14-D, 1951:61; H. E. L. Barton, oral communication, 1967.

Grizzly group

Bohemia District, 4

Location: Lane County, NE $\frac{1}{4}$ sec. 12, T. 23 S., R. 1 E., between 4000 and 4700 feet elevation.

Development: Three drifts, totaling about 800 feet, and several trenches explore vein for 2000 feet on strike and 600 feet vertical range.

Geology: Andesite and tuff intruded by small diorite dikes near vein which is 1 to 6 feet thick, strikes N. 60° W., dips 55° to 65° S., and contains silicified andesite, quartz, varying amounts of sphalerite, pyrite, chalcopyrite, and galena.

Production: Information lacking.

References: Stafford, 1904; Parks and Swartley, 1916:115; Callaghan and Buddington, 1938:68; Taber, 1949:43-44; Department Bulletin 14-D, 1951:65.

Helena mine

Bohemia District, 5

Location: Lane County, N $\frac{1}{2}$ sec. 18, SW $\frac{1}{4}$ sec. 7, T. 23 S., R. 2 E. and SE $\frac{1}{4}$ sec. 12, T. 23 S., R. 1 E. from about 4500 to 5400 feet elevation on Grizzly Mountain.

Development: Three principal levels contain about 2000 feet of drifts and crosscuts and about 500 feet of raises plus stopes.

Geology: The strong fissure vein which strikes N. 57° W. and dips 65° to 70° NE. has been explored for about 3000 feet. In mined area to the south the vein averages 4 feet thick. Country rocks are andesite and a large, east-trending granodiorite porphyry dike. Vein contains sphalerite, pyrite, chalcopyrite, galena, and a little tetrahedrite in a gangue of quartz rock fragments, kaolin, and barite. Shows good gold values in oxidized zone.

Production: Vein was discovered in 1896. There is a history of several owners and operators. Total production to 1950 was approximately \$250,000.

References: Diller, 1900:29-30; Parks and Swartley, 1916:234-235; Callaghan and Buddington, 1938:54-57; Taber, 1949:25-28; Department Bulletin 14-D, 1951:65-66.

Leroy group

Bohemia District, 6

- Location: Lane County, W $\frac{1}{2}$ sec. 12, T. 23 S., R. 1 E., about 4000 feet elevation; six patented claims.
- Development: Numerous cuts and tunnels have a total length of 1100 feet.
- Geology: The vein strikes N. 60° to 70° W., dips 55° to 70° SW., is 5 to 6 feet wide, and occurs in a southwest-dipping granodiorite porphyry dike. It contains quartz-cemented porphyry breccia with small to moderate amounts of sphalerite, chalcopryite, and galena and represents a large volume of low-grade material.
- Production: Most of development work was done between 1900 and 1910. Production, if any, is not reported.
- References: Stafford, 1904; Callaghan and Buddington, 1938:69-70; Taber, 1949:41; Department Bulletin 14-D, 1951:67-68.

Mayflower mine

Bohemia District, 7

- Location: Lane County, northeast corner sec. 20, T. 23 S., R. 2 E., about 3000 to 3400 feet elevation crossing Horseheaven Creek; five patented claims.
- Development: Two adits, one on each side of the creek, total length not reported. Some stopes 2 to 5 feet wide were mined to the surface.
- Geology: Country rock is tuff. Vein strikes N. 70° W., dips 75° to 80° N., and consists of altered tuff with a network of drusy quartz veinlets, considerable pyrite, and little sphalerite, galena, and chalcopryite.
- Production: Work was probably done in the late 1800's and early 1900's. There is evidence of considerable ore mined but no report of production available. A small cyanide mill (first in the district) was built on the property in 1909. The mine was operated by the Kelso Gold Mining & Milling Co. during 1913-1917.
- References: Stafford, 1904; Parks and Swartley, 1914:135; Callaghan and Buddington, 1938:70-71; Taber, 1949:39-40; Department Bulletin 14-D, 1951:68.

Musick mine

Bohemia District, 8

- Location: Lane County, N $\frac{1}{2}$ sec. 14 and NE $\frac{1}{4}$ sec. 15, T. 23 S., R. 1 E., between about 4300 and 5400 feet elevation.
- Development: There are about 7200 feet of drifts and crosscuts plus numerous stopes, raises, and winzes on the Musick vein. Numerous pits and short adits explore the branching California vein.
- Geology: Country rocks are mainly rhyolite with some andesite and tuff. Musick vein curves, splits, and merges with the west-striking California vein. It strikes from N. 45° W. to west, dips 65° S. to vertical, and varies from 3 to 12 feet in thickness. Ore is similar to that at Champion mine, but with higher lead content. Both the California and Musick veins have been explored for more than a mile along this strike to a depth of 800 feet.

Production: Mine was discovered in 1891 and worked extensively during early part of the century by various organizations. The mine was worked during the 1930's by the Minerals Exploration Co., which built a 22-ton mill and produced \$101,000 worth of concentrates. Estimated total production to 1949 has been about \$280,000. An extensive exploration drift was driven during 1961-1962.

References: Diller, 1900:20-23; Stafford, 1904; Parks and Swartley, 1916:234-235; Taber, 1949:28-30; Department Bulletin 14-D, 1951:69-70.

Noonday mine

Bohemia District, 9

Location: Lane County, W $\frac{1}{2}$ sec. 18, T. 23 S., R. 2 E., between 4900 and 5500 feet elevation; 5 patented claims.

Development: The mine workings have three main levels with nearly 4000 feet of drifts and cross-cuts and 600 feet of raises, plus extensive stopes.

Geology: The mine explores three nearly parallel veins about 100 yards apart. Development is on the central (Annie) vein, which strikes N. 45° to 70° W., and dips 75° to 80° S. It has been traced for about 1500 feet on the surface. Stopped areas were 3 to 8 feet thick and average about 5 feet thick with 1 $\frac{1}{2}$ to 2 feet of high grade. Country rocks are mainly labradorite andesite with nearby dacite plugs. Ore (sulfide) and gangue minerals are typical of the district.

Production: Fairly complete U.S. Bureau of Mines production records from 1891 to 1945 indicate a total of 5183 ounces of gold; 2087 ounces of silver, 10,282 pounds of copper; and 19,649 pounds of lead. In 1887 the mine was second in the district to produce. Taber (1949) calculated the total production at about \$100,000. Oxidized (free milling) ore was ground in a stamp mill.

References: Diller, 1900:28-29; Stafford, 1904; Callaghan and Buddington, 1938:60-62; Taber, 1949:31-33; Department Bulletin 14-D, 1951:70-71.

Oregon - Colorado mine

Bohemia District, 10

Location: Lane County, sec. 19, 29, and 30, T. 23 S., R. 2 E., between 3200 and 4000 feet elevation; 8 patented claims.

Development: The vein is explored by a lower (3300 feet elevation) adit drift 1800 feet long and an upper (3600 feet elevation) adit drift 450 feet long.

Geology: The Oregon-Colorado vein strikes about N. 50° W. and dips 60° to 65° SW. Vein filling is a quartz and chlorite-cemented breccia as much as 8 feet wide. The chief sulfides are chalcopyrite and pyrite. The vein crosses east-dipping, coarse- to fine-grained tuffs. A fine-grained andesite dike crops out at the portal of the lower tunnel. Selected ore samples reported assayed 1.0 ounce per ton gold, 3.4 ounce per ton silver, and 4.9 percent copper. Vein is explored for about 2000 feet.

Production: Most of the exploration was done by the Vesuvius Mining Co. prior to 1920. No production is reported.

References: Diller, 1900:28; Stafford, 1904; Parks and Swartley, 1916:228; Callaghan and Buddington, 1938:72-73; Taber, 1949:36-37; Department Bulletin 14-D, 1951:72.

I. C. 7512,
August 1949.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

A RECONNAISSANCE OF LODE MINES AND PROSPECTS IN THE BOHEMIA MINING
DISTRICT, LANE AND DOUGLAS COUNTIES, OREG. 1/

By John W. Taber 2/

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2/ Mining engineer, Albany Branch, Mining Division, Bureau of Mines.

The mine has been developed by three principal levels and three short adit drifts. Altogether, there are about 2,000 feet of drifts and crosscuts and about 500 feet of raises. All of the principal levels are connected by raises, so that the lowest (No. 7 level) may be used as a general haulage level for the mine. Except for about 100 feet of the No. 6 level, which has been stoped out, all of the drifts are open and in good condition.

All of the early mining was done in overhead and underhand open stopes with a few stulls and headboards to support weak sections of the hanging wall. The ground is not heavy but has a tendency to slough gouge and soft material from the hanging wall. Watkins believes that shrinkage stoping is the most suitable system for the Helena as well as other veins in the district. In some instances where the veins are narrow and the limits of the ore are sharp, a system of resuing or stripping in filled stopes might be equally as good and would permit mining much narrower ore shoots with minimum dilution of the ore.

The mine is equipped with track and air line throughout most of the principal drifts. A portable one-machine compressor and a minimum of small mine tools are at the mine. The outside improvements consist of a small tunnel house, a small metal-covered mill building, an ore bin of about 100 tons capacity, and a combination bunkhouse and cookhouse suitable for accomodating 20 men. The camp is supplied with running water from a spring cistern. Water from the spring plus mine water probably would be enough to operate a 50-ton flotation mill.

Musick Mine (Bohemia Mine)

The Musick mine is about a mile west of the Champion mine and on the opposite side of the main ridge that separates the City Creek and Champion Creek drainages. The main portal, at an altitude of 5,000 feet, is on the City Creek side near the base of Bohemia Mountain. The course of the vein is across a 5,400-foot spur ridge between the headwaters of Sharps Creek and City Creek. Timber is spotty and scrubby; the cover is chiefly low brush, particularly on the east slope, where the camp and mill were situated.

The Musick group consists of 14 unpatented claims situated in sec. 14, T. 23 S., R. 1 E., W.M. (fig. 2). The claims are owned by L. M. Capps, of Blackfoot, Idaho. In 1946 the property was under lease and option to purchase by the Tar Baby Mining Co. of Salt Lake City, Utah.

The mine is easily accessible by a good truck trail. It is 36 miles from Cottage Grove, Oreg., via the Champion mine. It is 1.8 miles beyond the Champion camp. The road is steep for about three-fourths of a mile from the Champion mine to the Champion saddle, from whence it is level along the ridge west to the mine.

James C. Musick is credited with the discovery of the Musick vein in 1891. The following year Musick is said to have erected a 5-stamp mill on the property. This was the second mill built in the district. Musick organized the Bohemia Gold Mining & Milling Co., which operated the mine and mill continuously until 1901. This was apparently the most sustained productive period of the

mine. The exhaustion of the free-milling oxidized ores marked the end of boom-period activity. Subsequently the Musick, Helena, and Champion mines were acquired by the Oregon Securities Corp. A 30-stamp mill with gravity concentrating equipment was built on the Champion property to treat sulfide ore from the group of mines. Ore from the Musick mine was transported by an electric tram to the Evening Star adit, where it was hauled to ore passes on the 600-foot level of the Champion workings and transferred to the 900-foot haulage level. At the portal of the 900-foot level it was transferred to a cable-bucket tram and conveyed to the old Champion mill about 3,000 feet down Champion Creek gulch.

The Oregon Securities Corp. developed and operated the mine from 1902 to 1907. In 1908 the three mines were sold to the West Coast Mines Co. This company did very little work in the Musick mine but held the property until 1921, when it was purchased by L. M. Capps of Blackfoot, Idaho. Capps rebuilt the 5-stamp mill on the property and operated it for several months. Thereafter the property remained idle until 1935, when it was leased by the Minerals Exploration Co. This company built a 22-ton gravity-concentrator mill. According to the manager of the mill, it operated during 1936 and 1937 to produce concentrates that yielded a net smelter return of \$101,000 and made a profit of \$18,000 for the company. No developing was done in the mine; consequently, the operation was shut down after the developed reserves were mined out. In 1939 the H & H Mines Co. took a lease and option on the property and drove a new winze level, which is said to have developed new ore bodies. Plans for operation were interrupted by the war. The H & H Mines Co. sold their lease and option to Kenneth O. Watkins in 1944. Watkins, in turn, sold the contract interest to the Tar Baby Mining Co. of Salt Lake City, Utah. This company retained the interest in 1946 but did no work at the mine.

Information compiled from various sources indicates that production from the Musick mine may have been about \$280,000. Measurements of the stopes indicate that the amount of rock stoped was at least 40,000 tons. At this figure the ore need only to have averaged \$7 per ton to amount to the reported value of ore produced.

The Musick vein, unlike others in the district, has wide variation in strike. This is partly because of various splits in the fissure and partly because the Musick vein merges into the California vein. The over-all trend of the Musick vein is about N. 60° W. However, segments of the vein have strikes ranging from N. 45° W. to S. 85° W. The California vein trends nearly due east. The veins dip at around 75° S.; local variations are from 60° S. to vertical. According to Callaghan and Buddington,¹⁹ the country rock is mostly light-colored rhyolite with some andesite and tuff.

Some of the ore shoots in the Musick vein have been among the largest found in the district. Three of the ore shoots have been mined for a horizontal distance of over 300 feet each and a vertical distance of over 180 feet (fig. 6). Others are mined for 75 to 100 feet horizontally and 50 to 100 feet on the dip. The stopes are 2 to 7 feet wide. The average width is about 4 feet.

¹⁹/ Work cited in footnote 4.

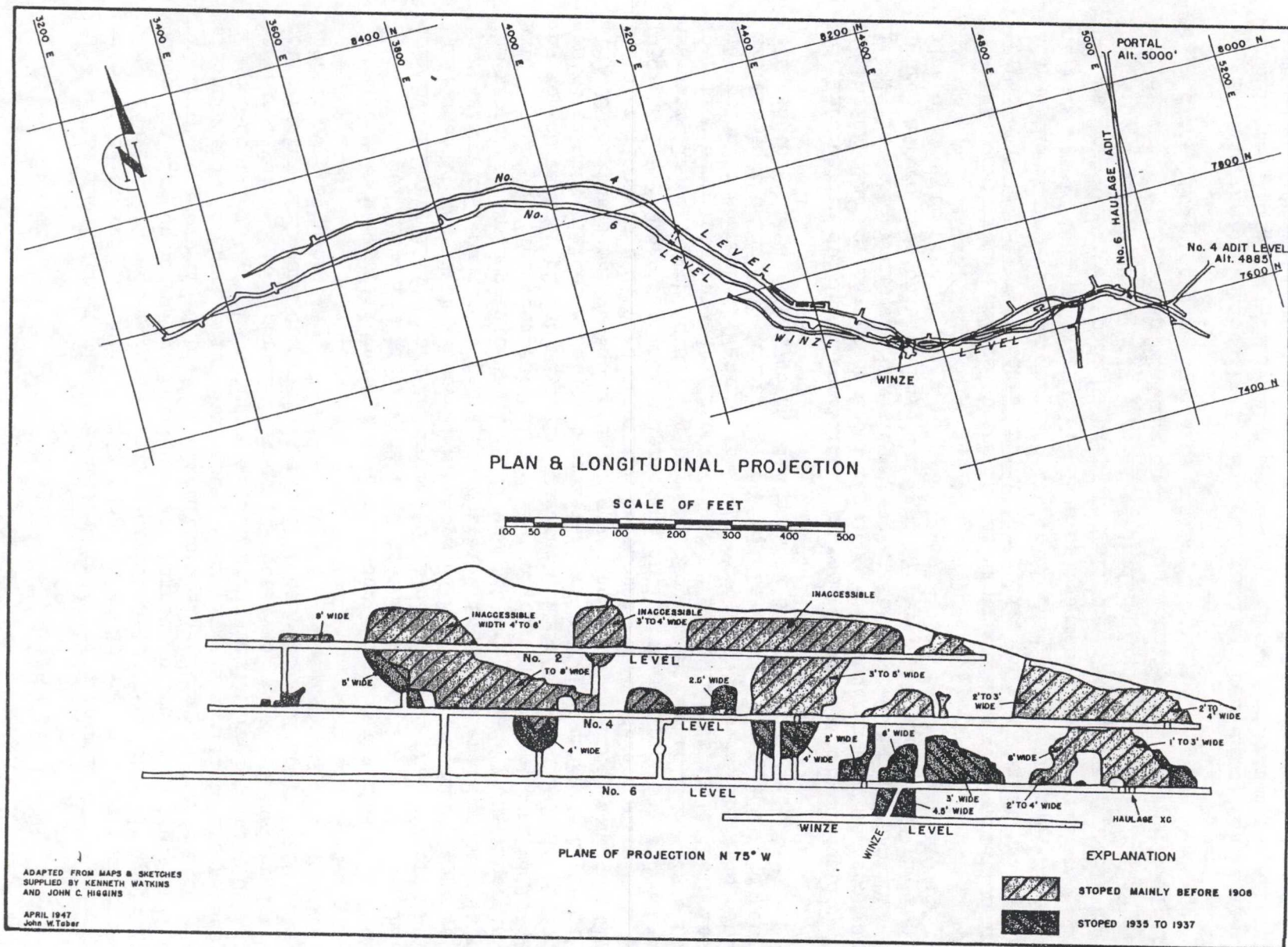


Figure 6. - Musick mine, Lane County, Oreg.

Musick ore is similar to the other gold-silver-sulfide ores of the district. It is a silicious-gangue ore containing fragments of wall rocks and the usual mixture of sulfides. The gold content is somewhat lower than in other veins in the district; the lead content is higher. A sample taken by Watkins for metallurgical testing at a commercial laboratory contained 0.12 ounce Au, 2.4 ounces Ag, 0.78 percent Cu, 9.4 percent Pb, and 3.8 percent Zn. This sample is said to represent developed ore in the mine in 1946. A grab sample of broken rock in the stopes taken by the author in 1946 contained 0.38 ounce Au, 1.7 ounce Ag, 1.2 percent Cu, 5.6 percent Pb, and 5.7 percent Zn. The sample contained some partly oxidized ore, which probably accounts for the somewhat higher gold content than is typical of Musick sulfide ore.

The Musick vein has been explored on four levels to an average depth of about 300 feet and for a horizontal distance of 1,900 feet (fig. 6). There are about 6,500 feet of drifts and crosscuts. About 1,700 feet of the horizontal distance explored is on the Musick vein. The remaining 200 feet is on the west end of the vein, where the California and Musick veins have merged. This section of the vein is considerably wider (8 to 12 feet) than the main Musick vein but contains less ore mineralization. Only one small stope has been opened on the merged California-Musick vein. At the surface the Musick vein has been traced by pits and outcrops a distance of 2,000 feet. The California vein has been similarly traced a distance of 1,500 feet to the point where it joins at a low angle with the Musick vein.

Most of the workings were open in 1946. Part of the No. 2 level had been mined through from below and was not readily accessible. The No. 4 level was blocked near the portal by a local cave but could be reached by raises from the No. 6 level. The latter was accessible throughout. The winze level, the most recent development, was filled with water in 1946.

All of the early mining was done by open stopes with a minimum of stull timbering installed primarily to facilitate mining in the stopes. Stopes mined 40 or more years earlier were in remarkably good condition in 1946. Only those near the surface had caved to any great extent. The most recent mining was done by shrinkage stoping. According to Watkins, who supervised most of this work, shrinkage stoping proved satisfactory for the sulfide ore bodies. The only timber used was for chutes and raises, with a few sets to support stope fill and local soft spots in the tunnel back.

All equipment except track had been removed from the mine. At the surface the track from the haulage level is partly covered with a steel snow shed. There is a small mill building and a coarse-ore bin of about 50 tons capacity.

The camp consists of a 30-man bunkhouse, a cookhouse, and four dwelling houses. The buildings are in fair condition. The camp water supply is dependent on a small intermittently flowing stream. Mine water would probably have to be used to supplement the stream supply for milling purposes.

The mine is located about 10 miles from the town of... The mine is situated on the... The mine is owned by...